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Final Environmental Impact Statement for Sludge Disposal in the Des Moines Integrated Community Area

Des Moines Integrated Community Area, IA

Prepared for

Environmental Protection Agency
Kansas City, MO

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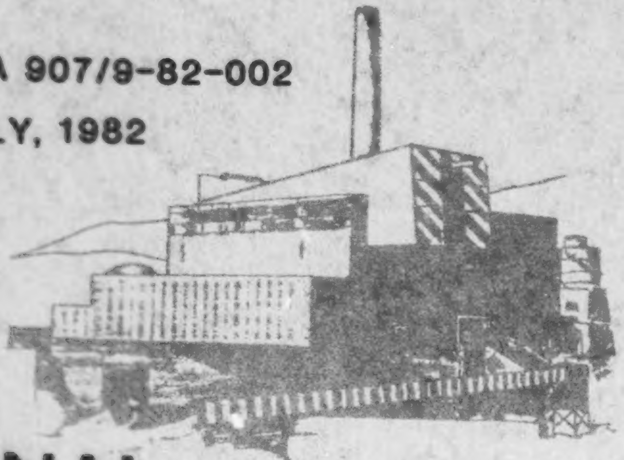
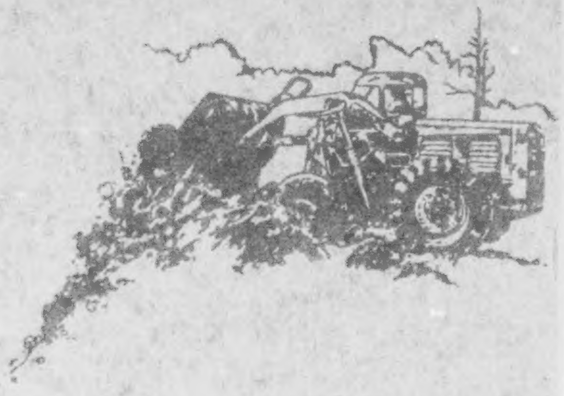
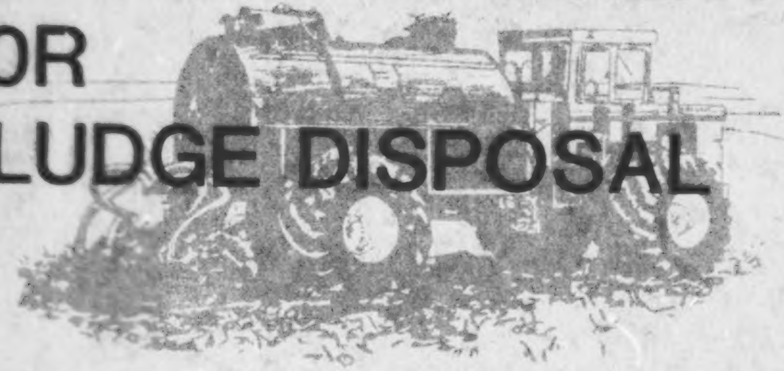




FINAL ENVIRONMENTAL IMPACT STATEMENT FOR SLUDGE DISPOSAL



IN THE

DES MOINES INTEGRATED COMMUNITY AREA

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VII
324 EAST ELEVENTH ST., KANSAS CITY, MO. 64106

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Environmental effects of alternative municipal wastewater sludge treatment and disposal methods in the Des Moines Integrated Community Area including Polk, Warren, and Marion Counties, Iowa. Eight basic alternatives were considered: 1) no action; 2) anaerobic sludge digestion, sludge dewatering, and land application of dewatered sludge at agronomic rates; 3) extended air composting and marketing of compost; 4) anaerobic sludge digestion, sludge dewatering, and landfilling; 5) anaerobic sludge digestion and land application of liquid sludge at agronomic rates; 6) extended air composting and coal mine reclamation; 7) extended air composting and landfilling; and 8) anaerobic digestion, sludge dewatering, and coal mine tion. The coal mine reclamation alternatives provide the greatest benefit among the project alternatives, followed by land application and landfilling of dewatered sludge. Although the absolute impacts among these alternatives are not that different, improvement of the mine spoil sites results in a much greater site-specific beneficial impact. Land application of liquid sludge would have the greatest negative impact due to adverse socioeconomic factors. Land application of dewatered sludge at agonomic rates is the stated preferred alternative.

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ENVIRONMENTAL IMPACT STATEMENT
FOR SLUDGE DISPOSAL

FOR THE

DES MOINES INTEGRATED COMMUNITY AREA

U.S. ENVIRONMENTAL PROTECTION AGENCY

JULY, 1982

APPROVED BY:

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IN ASSOCIATION WITH

ENGINEERING-SCIENCE, INC.

This Final Environmental Impact Statement for Sludge Disposal in the Des Moines Integrated Community Area is the same as the Draft EIS with the following exceptions:

Page xvi - Summary of public hearing and comments on Draft EIS added.

Page 5 - Figure reference added.

Page 70 - Statement added.

Appendix B - Comments and responses provided.

Appendix C - Public hearing transcript provided.

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EXECUTIVE SUMMARY

EXISTING PROBLEM

The Des Moines Integrated Community Area (ICA) has submitted to the EPA a construction grant application for sewage solids management facilities associated with the proposed Des Moines Regional Wastewater Treatment Plant. The proposed solids management facilities are needed to accommodate increased sludge volumes associated with the proposed new wastewater treatment plant and to prevent pollution associated with improper treatment, handling, and disposal of sewage sludge. The existing sludge digester covers, sand drying beds, and mechanical dewatering equipment at the Des Moines Main Plant are in need of repair or replacement. Further, problems with achieving an adequately dewatered sludge for landfilling occur periodically. These problems, thus, constitute occasional operation problems which are a health hazard as well as a source of environmental pollution. A solution has been proposed and alternative actions developed. The purpose of this document is to identify and characterize the environmental impacts of the Des Moines ICA Agency's proposed action and alternatives (including no-action) for wastewater treatment sludge management.

ALTERNATIVES, IMPACTS, AND POSSIBLE MITIGATION

Proposed Action

The ICA Agency's proposed action (Alternative 1a) includes the use of dissolved air flotation for sludge thickening, anaerobic digestion for stabilization, a belt filter press for dewatering, truck transportation, and ultimate disposal via land application at agronomic rates. Methane gas, generated during digestion, will be captured and utilized to heat the digesters and/or produce electricity for in-plant use. Land utilized for land application will remain in private ownership. Sludge transport and application will be conducted by the ICA Agency. A continuing public education and coordination program will be required to ensure that the necessary acreage (4,100 acres per year) is available for sludge application.

Alternatives

The No-Action Alternative would involve continuation of the operation and maintenance of deteriorating solids management facilities at the Des Moines Main Plant and several other wastewater treatment facilities within the ICA. Approximately 12,300 dry tons would continue to be disposed at the Metro East Sanitary Landfill, and 1,140 dry tons would continue to be land applied annually.

In addition to the No-Action and the proposed alternative, nine others were evaluated. These are summarized below:

Alternative 1b

Alternative 1b is identical to the proposed action except for stabilized sludge dewatering. Instead of utilizing a belt filter press, dewatering is by centrifuge.

Alternative 2

Alternative 2 uses composting for the sludge stabilization process, with the finished product being transported by truck and marketed as a fertilizer. The total treatment process includes dissolved air flotation for thickening, belt filter press for dewatering, composting for stabilization, and truck transport to fertilizer markets.

Alternatives 3a and 3b

Alternatives 3a and 3b are identical except for the digested sludge dewatering process. These alternatives are similar to Alternatives 1a (proposed action) and 1b in that 3a uses a belt filter press and 3b uses a centrifuge. The overall processes are also similar to Alternatives 1a and 1b, the only difference being the ultimate disposal is landfilling instead of land application. The existing Metro East Landfill is considered the ultimate disposal location in this alternative.

Alternative 4

Alternative 4 is a liquid sludge land application process. The alternative includes dissolved air flotation for thickening, anaerobic digestion for stabilization, truck transport, and liquid sludge land application at agronomic rates. Alternative 4 is the same as Alternatives 1a and 1b without the dewatering step. Methane gas is captured and utilized for in-plant energy.

Alternative 5

Alternative 5 is a composting system. As in Alternative 2, the extended aeration composting is preceded by dissolved air flotation thickening and belt filter press dewatering. Alternative 5 differs from the previous composting alternative in that ultimate disposal would be land reclamation of orphan coal strip mines. Truck transport is utilized to haul composted sludge from the treatment plant to strip mines located in Marion County, Iowa.

Alternative 6

Alternative 6 is another composting system. It is similar to Alternative 5 except ultimate disposal is by landfilling. Truck transport of compost to the Metro East Landfill is prescribed.

Alternatives 7a and 7b

Alternatives 7a and 7b are land reclamation systems using anaerobically digested sludge. The systems begin with dissolved air flotation followed by the anaerobic digestion step. The difference between 7a and 7b is the dewatering system. Alternative 7a prescribes a belt filter press, while Alternative 7b dewaters via centrifuge. Following dewatering, the sludge is transported via truck to land reclamation sites in Marion County, Iowa. Methane gas is also captured and utilized as an energy source under these alternatives.

No-Action Impacts

Impacts on the physical environment would include effects related to groundwater quality, air quality, and energy. Groundwater impacts may include deterioration of groundwater resources in the vicinity of the Metro East Landfill from the continued disposal of inadequately dewatered sludge. Air quality impacts are primarily those from sludge transport truck emissions. Air pollutant burdens associated with no action are less than any other alternative. Petroleum-derived energy is required for sludge digestion and transport. Because digester gas is not recovered, no action required substantial energy inputs. Impacts on the social environment are primarily secondary effects attributable to not building the sludge management facilities and possibly jeopardizing the construction of the proposed wastewater treatment facilities. These relate to demography, land use, economic factors, and transportation. Without new treatment facilities, economic development may be constrained; pressure to develop land planned for low intensity development may increase because on-site wastewater disposal systems will be necessary; and/or projected population growth rates and planned distribution patterns may not be realized. Also, if the new plant is not built, continued violations of water quality standards in the Des Moines River can be expected.

Proposed Action Impacts

Impacts on the physical and natural environment include effects in the areas of soils, surface water and groundwater quality, air quality, noise, energy, and terrestrial and aquatic flora and fauna. Soils impacts include accumulations of heavy metals and additions of productive nutrients and organic material related to the application of sludge on cropland. Water quality, air quality, noise, aquatic flora and fauna, and terrestrial fauna may be adversely affected to a limited degree over the long term. These impacts are directly related to sludge transport and sludge application. With the exception of air quality and terrestrial fauna exposure to heavy metals, these impacts may be substantially mitigated through careful selection of sludge haul routes and proper management of the sludge application program. Heavy metal accumulations in soils can be attenuated through an industrial pretreatment program which would remove a significant portion of the metals currently found in the sludge. Energy and terrestrial flora effects will be beneficial. Because digester gas will be captured and utilized, the sludge management system will produce more energy than it consumes. Terrestrial flora will benefit from the nutrients and organic matter contained in the applied sludge.

Socioeconomic effects may be realized in the areas of demography, land use, economics, transportation, aesthetics, and public health. Impacts on demography, land use, and economics, although minimal, should be beneficial. By providing a free or low-cost fertilizer to area farm operators, agricultural activities may be encouraged. Since local land use plans pursue the continuation of agricultural activities, a small positive impact may be realized. Population distribution should be encouraged in areas planned for higher development densities since waste collection and treatment facilities will be located there. Economically, direct costs of the proposed action are greater than no action. However, no action involves indirect costs of continued pollution and related effects. Moreover, the proposed action may provide a revenue-generating product (sludge) and would reduce the local share of construction and operating costs from other action alternatives which do not propose innovative technology (federal share of grant-match formula is increased). An estimated six additional jobs (long term) would be created at the wastewater treatment plant.

Minor adverse effects on transportation, aesthetics, and public health may occur. The transport of sludge to area farms will necessitate a moderate increase in truck traffic on both primary and secondary roads. This could accelerate roadway deterioration in some areas. However, coordination between the ICA Agency and county engineering departments will allow for mitigation through consideration of sludge haul routes in local road improvement planning efforts. Aesthetics and public health may be adversely effected to a slight degree. The application of sludges on farmland does increase the potential for public contact with the sludge and public exposure to odors. Odor nuisance will be mitigated by avoiding sludge applications in close proximity to populated areas (i.e., residential developments and commercial/retail districts). Iowa Department of Environmental Quality Rules require restriction of public access to sludge application sites for a two-month period following sludge application. Adherence to these rules will greatly mitigate public health risks associated with direct sludge contact.

The proposed action will have no effect on topography, geology, hydrology, archaeological and historical resources, or recreation. Topography or geology will not be altered; no additional floodplain intrusions will occur; application of sludge on farmland will have no effect on archaeological resources which may be present; no historical buildings or sites will be directly or indirectly affected; and recreational lands will not be involved in the project.

Alternative 1b Impacts

Since Alternative 1b is similar to the proposed action, with the exception of the sludge dewatering step, anticipated impacts are virtually identical to those described above. Alternative 1b includes dewatering via centrifuge instead of a belt filter press. The most notable differences between these two processes are:

- Lower capital cost

- Higher operation and maintenance costs

- Additional noise generation at the plant

Since centrifuge dewatering is a confined process outside of the noise, there is little environmental impact.

Alternative 2 Impacts

Impacts stemming from sludge composting and marketing will not be appreciably different from land application of dewatered sludge. The most notable differences will occur at the treatment plant where an additional fifteen acres of land would be utilized for compost production and storage. Odors and airborne pathogens from composting operations would be elevated; net energy utilization would be considerably higher because methane gas would not be collected and utilized; and noise levels from compost handling operations would be higher.

Impacts on the physical and ecological environment include effects on soils, water quality, air quality, noise, energy, aquatic flora and fauna, and terrestrial flora and fauna. Soils amended with compost will receive beneficial nutrients and organic materials but will also be subject to accumulations of heavy metals, an adverse effect. Surface water and groundwater could be adversely affected if compost is applied to areas subject to runoff or where soil and groundwater conditions are conducive to nitrates entering surficial aquifers. While the potential for adverse water quality impacts is slight, it is unavoidable since no control can be exercised over the ultimate use (disposal) of compost under Alternative 2. Air quality impacts from transport vehicle emissions are anticipated to be similar to the proposed action; however, odor and airborne pathogen problems will be somewhat more pronounced leading to adverse aesthetic and possible public health effects. The potential for adverse aquatic flora and fauna effects is directly related to the potential for adverse surface water impacts previously discussed. Such effects would tend to be localized and short term.

Socioeconomic effects would be largely the same as under the proposed action, with the exception of aesthetics as previously discussed. Also, since compost presumably would not be as widely used on cropland as dewatered sludge, any incentive for continued agricultural land uses provided by the proposed action would be somewhat attenuated. Some minor benefit to recreational land may be realized since compost could be utilized on golf courses and other green spaces.

Alternative 3a Impacts

Impacts on the physical and ecological environment would include effects in the areas of air quality; energy; solid waste disposal capacity; and, potentially, groundwater. Dust from plant construction and landfill operations will be localized, with construction-related dust being a short-term problem. Sludge transport vehicle emissions will also add air pollutants but will have a negligible effect on air quality in the ICA. The planned use of digester gas to generate electricity and/or heat for in-plant utilization offers the potential for energy conservation, although petroleum-based fuels will be consumed by sludge transport and disposal equipment. Existing landfill capacity will be consumed but at a rate roughly equal to the No-Action Alternative. Groundwater contamination in the vicinity of the landfill is a potential problem. However, no groundwater problems have thus far been reported. Proper design and operation of landfills can mitigate groundwater pollution problems. Socioeconomic effects are similar to the No-Action Alternative without any potential for adverse land use implications.

Because the existing landfill is utilized and no apparent, environmental problems have been reported, no adverse effects on topography, geology, surface water, hydrology, aquatic or terrestrial flora and fauna, demography, land use, cultural resources, aesthetics, public health, or recreation are anticipated. The primary disadvantage with Alternative 3 is that resources (i.e., nutrients and organic material in sludge) are not recycled but discarded.

Alternative 3b Impacts

The only difference between Alternatives 3a and 3b is the sludge dewatering step. Alternative 3a utilizes a belt filter press, while dewatering is accomplished via centrifuge in Alternative 3b. The differences between these processes are described under "Alternative 1b Impacts." Since centrifuge dewatering is a confined process, outside of the additional noise, impacts of Alternative 3b are identical to those described for 3a.

Alternative 4 Impacts

The areas of impact described for the proposed action are the same as those for Alternative 4. The major differences lie in the magnitude of potential adverse impacts on water quality, public health, and aquatic flora and fauna, as well as the actual degree of impact in the areas of air quality, noise, energy, and transportation. The potential for adverse effects on water quality, public health, and aquatic life is greater for land application of liquid sludge than for land application of dewatered sludge. Liquid sludge, if not immediately incorporated with the soil, has a higher potential for runoff into adjacent surface watercourses, consequently impacting water quality and aquatic life. The potential for adverse public health effects is also greater with liquid sludge primarily associated with increased vector population at storage facilities. Proper management of land application and storage sites can mitigate those potential problems. Because liquid sludge is considerably more voluminous than dewatered sludge, a significant increase in sludge haul trips and total haul miles is required. Consequently, truck traffic increases are substantial; associated air emissions are greater; energy requirements are greater; and increases in traffic noise are expected. For the most part, these impacts are unavoidable.

Alternative 5 Impacts

Impacts on the physical and ecological environment include effects in the areas of topography, geology, soils, water quality, air quality, noise, energy, and terrestrial and aquatic flora and fauna. Topographic and geologic impacts will be beneficial and occur as a result of recontouring abandoned coal strip mines and sealing exposed coal seams along high walls. Long-term benefits to soils and water quality in strip mine areas are also anticipated. The addition of compost to mine spoil tailings will allow for the establishment of herbaceous vegetation where presently none exists. Further, the addition of lime and compost will eventually mitigate the acidity of mine water flowing to groundwater and surface water resources. Mitigation of acid mine water runoff will have a localized beneficial effect on aquatic flora and fauna. Successful mine reclamation efforts reestablish natural succession processes; consequently, plant and animal life on the sites will become more diverse with time. An unavoidable impact will be the accumulation of heavy metals in soils at the reclamation site. Implementation of an industrial pretreatment program will help to mitigate this impact. Air quality impacts will stem from emissions from compost transport trucks, earth moving equipment, dust generated during reclamation activities, and odors and airborne pathogens from compost production. Water sprays can mitigate, to a certain degree, fugitive dust and airborne pathogens. Vehicle emissions are unavoidable. Noise impacts will occur at the plant where compost production and handling occurs, along haul routes from truck traffic, and at the mine reclamation site(s) from heavy equipment operation. Noise impacts, however, will be relatively minor. Petroleum-derived energy will be consumed as well as electrical energy from coal. Composting will not provide the opportunity to capture methane gas.

Socioeconomic impacts will include effects on land use, employment, property tax base, transportation, and public health. Impacts on land use, employment, and the property tax base, although beneficial, will be minor. Approximately six new long-term jobs would be created. Reclaimed coal mines could be utilized for agricultural purposes which is consistent with adjacent land uses; and, presumably, reclaimed mine sites would have a higher economic value and be taxed accordingly.

Alternative 6 Impacts

Impacts on the physical and ecological environment would include effects on air quality; noise; energy; and, potentially, groundwater. Possible groundwater effects include leachate contamination from the landfill. However, because the existing landfill would be utilized and no groundwater problems have been reported, groundwater contamination problems are not anticipated. Proper design and operation of landfill facilities can mitigate such potential effects. Air quality impacts will stem from emissions for transport vehicles, landfill vehicles, dust generated at the landfill, and odors and airborne pathogens from compost production. The latter two are anticipated to impact the vicinity of the treatment plant. Dust and airborne pathogens can be controlled with water sprays, although dust control on the working face of a landfill is impractical. Vehicle emissions are unavoidable. Noise will be generated at the plant from compost processing and handling operations, along haul routes, and at the landfill. Only noise level increases at the plant will be noticeable. Petroleum-derived energy will be consumed as well as electrical energy. As with the other composting alternatives, methane gas will not be captured or used for energy. Landfill capacity will also be consumed at about the same rate as under the No-Action Alternative.

Few minor socioeconomic impacts are anticipated. These include adverse effects on plant economics, transportation systems, aesthetics, and public health. Aesthetic and public health impacts are related to odors and airborne pathogens in the vicinity of the plant. A slight increase in truck traffic for compost hauling is anticipated, and the cost of sludge processing will increase over the No-Action Alternative.

Alternative 7a Impacts

Impacts on the physical, ecological, and social environment are similar to those described for the other land reclamation alternative (Alternative 5). Differences between these alternatives are stated below. These differences stem from the stabilization process utilized (i.e., anaerobic digestion instead of composting).

Topography, geography, soils, and water quality would experience long-term beneficial effects as described for Alternative 5. Soils would not be effected to as great a degree. Reclamation utilizing dewatered sludge requires that topsoil from off-site be incorporated with the sludge to provide a suitable medium for plant growth; whereas, compost provides the medium without additional soils. Adverse air quality and noise impacts will be similar to Alternative 5, although some reduction in odors, airborne pathogens, and noise will be realized at the plant. This is because anaerobic digestion is a contained process, and the amount of equipment necessary for compost curing and handling is not required. The most important difference is between the energy requirements. Alternative 7a provides the opportunity to capture and utilize methane gas. Because of this feature, a net energy gain is expected, although some petroleum-derived energy will be consumed for sludge transport and reclamation activities.

Alternative 7b Impacts

As with Alternatives 1a/b and 3a/b, the only difference between Alternatives 7a and 7b is the dewatering step. Alternative 7a employs a belt filter press, while Alternative 7b employs a centrifuge. A discussion concerning the impacts associated with centrifuge dewatering is provided under Alternative 1b. Other impacts are the same as those described above for Alternative 7a.

AREAS OF CONTROVERSY

To date, the proposed sludge management program has met with little controversy. Four issues were raised by the Polk County Physical Planning Department and are listed below:

1) "The apparent, predetermined conclusions that land application of the sludge is the most desirable alternative."

2) "The problem of contamination of stormwater runoff and air pollution due to land application, especially the stockpiling of sludge."

3) "The problem of heavy metal buildup in agricultural land due to extensive or extended application of sludge."

4) "The impact on the county road system due to increased truck loads and/or spillage."

These issues have been addressed in detail in appropriate sections of the full Environmental Impact Statement text.

CONCLUSIONS

Overall, the land reclamation alternatives provide the greatest benefit among the project alternatives, followed by land application and landfilling of dewatered sludge. The primary reason for this is that baseline (existing) conditions of the mine spoil sites are comparably poor when matched against the baseline conditions of the land application or landfill sites. Consequently, although absolute impacts on land reclamation and land application sites are not that different, improvement of the mine spoil sites results in a much greater site-specific beneficial impact.

Land application of liquid sludge (Alternative 4) would have the greatest negative impact due to adverse socioeconomic factors primarily related to transportation and storage. Other alternatives which would have an overall negative impact relative to baseline conditions include the No-Action Alternative and Alternatives 2 and 6.

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Federal Agencies

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U.S. Department of Housing and Urban Development
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    National Park Service
    Geological Survey

U.S. Department of Transportation
  Federal Highway Administration
  Coast Guard
  Federal Aviation Administration

Members of Congress

Neal Smith, U.S. House of Representatives
Roger Jepsen, U.S. Senate
Charles Grassley, U.S. Senate

State

Iowa "A-95" Coordinator, Governor's Office
Iowa Department of Environmental Quality
State Library Commission of Iowa
State Historical Department of Iowa
Office of the State Archaeologist
Iowa Department of Soil Conservation
Iowa Department of Agriculture
Iowa Department of Health
Iowa Conservation Commission
Iowa Development Commission
Iowa Department of Transportation
State Office for Planning and Programming
Iowa Energy Policy Council
State Extension Service
Iowa State University
Natural Resources Council

Local and Regional

City of Alleman
City Altoona
City of Ankeny
City of Bondurant
City of Carlisle
City of Clive
City of Cumming
Dallas County
City of Des Moines
City of Elkhart
City of Granger
City of Grimes
City of Hartford
City of Johnston
City of Mitchellville
City of Norwalk
City of Pleasant Hill
City of Polk City

Polk County
City of Runnells
City of Spring Hill
City of Urbandale
Warren County
City of Waukee
City of West Des Moines
City of Windsor Heights
Central Iowa Regional Association of Local Governments
Health Planning Council of Central Iowa
Marion County

Interested Individuals

Sue Martin, Public Participation
City of Des Moines

Ivan Mauk
The Iowa Packing Company

Darrel A. Palmer, Administrative Assistant
City of Salem

Ronald L. Cooper, P.E.
CEF Consulting Engineers, P.C.

Rhoda Granat, Librarian
WAPORA, Inc.

H. M. Coggeshall
Bradshaw, Fowler, Proctor & Fairgrave

L. D. McMullen, Ph.D., P.E.
Des Moines Water Works

Linda Applegate
Sierra Club
Central Iowa Group

Ober J. Anderson
Polk County Agricultural Extension Director

Joseph Narigon
Warren County Agricultural Extension Director

Richard Davis
Polk-Des Moines Taxpayers Association

Dr. Merwin Dougal, Director
Iowa State University
Water Resources Institution

Mark Threlkeld
Greater Des Moines Chamber of Commerce

Stu Melvin
Agricultural Engineering Extension
Iowa State University

Dr. Tabatabai
Agronomy Department
Iowa State University

Jerry L. Hadenfeldt
Meridith Corporation

Percy Magee
Soil Conservation Service

Lee Dallager
Des Moines Area Wastewater Project
Citizens Advisory Committee

Marilyn Staples
Des Moines Area Wastewater Project
Citizens Advisory Committee

Robert Wilkins
Des Moines Area Wastewater Project
Citizens Advisory Committee

William Mills
Des Moines Area Wastewater Project
Citizens Advisory Committee

Cavid Courann
Des Moines Area Wastewater Project
Citizens Advisory Committee

Jeffery Segin
Des Moines Area Wastewater Project
Citizens Advisory Committee

Russell Clingan
Des Moines Area Wastewater Project
Citizens Advisory Committee

Charles Wasker
Des Moines Area Wastewater Project
Citizens Advisory Committee

James Donahue
Des Moines Area Wastewater Project
Citizens Advisory Committee

Harold Rathert, Chairman
Science Department
Des Moines Public Schools

Burgess Shriver
Math and Science Department
Des Moines Area Community College

Jim Ferro
Central Iowa Regional Association of Local Governments

Greg Nabstad
Des Moines Environmental Advisory Committee

John Neubauer

W. James Hall, Jr.
Pioneer Hi-Bred Internatioal, Inc.

Leo Johnson, Director
Department of Public Works, Des Moines

Ray Henely
Associated General Contractors of Iowa

Richard E. Gardner
American Society of Landscape Architects

Fred Lock
United Federal Savings and Loan Company, Des Moines

Tom L. Robinson
Iowa Limestone Producers Association, Inc.

Russ Stammer

Bob Ziesman
Iowa Realty Company, Inc.

Ron Dichson
Iowa-Des Moines National Bank

John C. McClellard
Asphalt Paving Association of Iowa

Casey P. Shanahan
Iowa Taxpayers Association

Lester L. Phodes
Iowa Soybeans Association

Ralph Schleaker, Vice President
Iowa Power and Light Company

Edith Crist
American Association of University Women

Vincent Bobenhouse
U.S. Power Squadron, Des Moines

Thomas D. McMillan, Executive Director
American Road Builders Association of Iowa

Joe Blodgett, Executive Secretary
Des Moines Construction, Inc.

George Hampel, Jr., Executive Director
Des Moines Educational Association

Earl L. Ring, Executive Vice President
Iowa Association of Electric Coops

Donald E. Krist, Executive Vice President
Iowa Association of Mutual Insurance Agents

M. J. Knutson, Executive Director
Iowa Concrete Paving Association

Richard Malm, Attorney
Dickinson, Throckmorton, Parker, Munnheimer and Raife

R. M. Oothout
Iowa Power and Light Company

Stan Moore
Des Moines Power Squadron

Harlan W. Rigby
Polk County Farm Bureau

John W. Judge
American Federal Savings and Loan Association

Wayne J. Jennesy
Society of Real Estate Appraisers

George Green
Crown Redi Mix

Dr. Robert Schultes
Broadlaws Polk County Hospital

Miriam Bond
Government Publications Department
Iowa State University

Colonel Wayne Daffron
National Guard of Iowa

Julius S. Conner, M.D.
Director of Public Health, Des Moines

Interested Groups

Iowa Confederation of Environmental Organizations
Iowa Conservation Education Council, Inc.
Southeast Polk High School Ecology Club
American Institute of Architects
Iowa Association of Municipal Utilities
Iowa Farmers Union
National Association of Regional Councils
Izaak Walton League, Ankeny Chapter
"Ding" Darling Foundation, Inc.
National Pork Producers Council
West Des Moines Chamber of Commerce
Rotary Club of Des Moines
Ankeny Chamber of Commerce
Warren County Farm Bureau
Des Moines Women's Clubs
Kiwanis Downtown Club
Lions Club of Greater Des Moines
Girl Scouts of America
Izaak Walton League of America, Iowa Division
Boy Scouts of America
Des Moines Minority Contractor Association
Executive's Association, Inc.
Industries Council of Des Moines
Iowa Association of Life Underwriters
Iowa Association of Secondary School Principals
Iowa Bankers Association
Iowa Ornithologists' Union
Sierra Club, Iowa Chapter
Nature Conservancy
State Preservation Board
Iowa Commercial Fisheries Association
Ducks Unlimited
Wildlife Society
Citizens for Environmental Action
Iowa Wildlife Federation, Inc.
Izaak Walton League
Iowa Manufacturers Association
Iowa League of Conservation Voters
League of Women Voters of Greater Des Moines
Citizens for Community Improvement
Home Builders Association, Joy A. Cole, Executive Vice President
League of Iowa Municipalities
Government Publications Department, Cowles Library, Drake University
Iowa Natural Heritage Foundation

PUBLIC HEARING AND COMMENTS ON DRAFT EIS

After the January, 1982, publication of the Draft EIS, a public hearing was held on April 6, 1982, in the Des Moines City Council Chambers. Twenty people attended, and only one citizen gave a statement and asked several questions related to the mine reclamation alternatives and existing landfill life expectancy. Very few comment letters were received, most of which simply acknowledged receipt of the Draft EIS and contained no comments. Significant comments received related to concerns for protecting the public health through proper management of sludge storage and land application sites and monitoring of nearby drinking water wells and surface waters. Responses point out applicable rules, regulations, and agencies responsible for management and monitoring of land application areas and affected populations and environmental resources. All comments and responses are provided in Appendix B of the Final EIS. The public hearing transcript is contained in Appendix C.

CHAPTER I

INTRODUCTION

BACKGROUND/PROJECT HISTORY

In 1977, the Central Iowa Regional Association of Local Governments (CIRALG) prepared the Des Moines 208 Metropolitan Areawide Waste Treatment Management Plan pursuant to Section 208 of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500). The plan included structural and nonstructural programs for the control of point, intermittent point, and nonpoint pollution sources. Included among the proposed point source actions for the central urban area was the construction of a new sewage treatment facility adjacent to the existing Des Moines Wastewater Treatment Plant. It was proposed that the new facility would eventually serve a multijurisdictional area comprised of ten municipalities and certain unincorporated areas. Thus, the Integrated Community Area (ICA) was formed through an interlocal agreement between the following communities: Altoona, Ankeny, Bondurant, Clive, Des Moines, Johnston, Pleasant Hill, Urbandale, West Des Moines, Windsor Heights, Polk County, Warren County, Windsor Heights Sanitary District, and Urbandale Sanitary District.

The U.S. Environmental Protection Agency (EPA) determined that approval of the Des Moines 208 Plan was a major federal action with the potential of affecting the quality of the human environment. As required under Section 102(2)(c) of the National Environmental Policy Act of 1969 (Public Law 91-190), EPA prepared an environmental impact statement (EIS) regarding approval of the 208 Plan. The EIS identified the generation of sludge as a potential adverse environmental impact associated with the operation of a centralized treatment facility. EPA found that the discussion in the Des Moines 208 Plan on sludge processing and disposal to be inadequate, noting that the methods used to dispose of and/or apply the sludge will determine the degree and kinds of impacts which may result and recommended that an EIS be prepared on the sludge management aspect of the Des Moines project.

On June 13, 1980, the city of Des Moines, acting as the lead ICA agency, received approval from the U.S. EPA for a Step I grant under Section 201 of the Clean Water Act. The Step I grant was for the preparation of a Facility Plan to update the 208 Plan recommendations regarding the centralized wastewater treatment plant proposed to serve the ICA. Because an EIS was previously approved for the 208 Plan and the wastewater treatment facilities proposed therein, another EIS would not be necessary for the full 201 Facilities Plan. However, because the previous EIS was found to be deficient with regard to sludge processing and disposal, the U.S. EPA determined that an EIS would be prepared for the sludge management portion of the Des Moines 201 facility by the "piggyback" method. On November 20, 1980, Des Moines entered into a Memorandum of Understanding with EPA regarding the method of EIS preparation and the primary responsibilities therein.

WHY THIS DOCUMENT WAS PREPARED

The National Environmental Policy Act (NEPA) requires every federal agency to prepare a detailed statement on environmental impact for each of its major proposed actions significantly affecting the environment. In this case, the Environmental Protection Agency is proposing to approve a Facilities Plan for the management and disposal of sludge by the Des Moines Integrated Community Area.

EPA's responsibility for the approval of a wastewater treatment facility is given to it under Public Law 92-500, known as the Water Pollution Control Act Amendments of 1972.

EPA has decided that approval of this plan constitutes a major, significant action under NEPA and is, therefore, preparing a detailed environmental impact statement. An environmental impact statement (EIS) must consider the environmental impacts of a proposed action, both short and long term (and especially the irreversible, adverse kinds), and alternatives to the action.

Under Title II of the Water Pollution Control Act Amendments, EPA is given authority to distribute construction grant fundings for municipal wastewater treatment facilities. This section of the Act defines a three-step process of planning (Step I), design (Step II), and construction (Step III) that must be fulfilled for an eligible grant applicant to construct a facility with federal funds.

The Step I process works as follows: an applicant who is certified through a state priority system prepares a Facilities Plan. EPA will pay 75 percent of the costs of such a plan. Before a plan can proceed to the design and construction phase, the plan must be approved by EPA. Design (Step II) review is delegated to the state. EPA has determined that the approval process of a Facilities Plan constitutes the federal action under NEPA.

Sludge treatment and disposal units are considered an integral part of the wastewater treatment process and, hence, are eligible for funding. Section 212(A) of the Act defines such facilities to include land acquisition costs if they are part of the treatment process:

> "The term 'treatment works' means any devices and systems used in the storage, treatment, recycling, and reclamation of municipal sewage or industrial wastes of a liquid nature. . .including site acquisition of the land that will be an integral part of the treatment process or is used for the ultimate disposal of residues resulting from such treatment."

The Congressional philosophy for the need to recycle and reclaim many of the pollutants in sewage, including sludge, in a beneficial manner is clear in Sections 201(d), (e), and (f) of the Act:

"(d) The Administrator shall encourage water treatment management which results in the construction of revenue producing facilities providing for --

> (1) the recycling of potential sewage pollutants through the production of agriculture, silviculture, or aquaculture products, or any combination thereof;
>
> (4) the ultimate disposal of sludge in a manner that will not result in environmental hazards.

(e) The Administrator shall encourage waste treatment management which results in integrating facilities for sewage treatment and recycling with facilities to treat, dispose of, or utilize other industrial and municipal wastes, including but not limited to solid waste and waste heat and thermal discharges. Such integrated facilities shall be designed and operated to produce revenues in excess of capital and operation and maintenance costs, and such revenues shall be used by the designated regional management agency to aid in financing other environmental improvement programs.

(f) The Administrator shall encourage waste treatment management which combines 'open space' and recreational considerations with such management."

In addition to the environmental considerations required under NEPA, EPA must determine whether the facility considered in this plan meets the goals of the Federal Water Pollution Control Act Amendments of 1972 stated above.

The Des Moines Integrated Community Area has submitted a Facility Plan to EPA and the state of Iowa to process and dispose of its sludge by recycling it to the land. This EIS considers the effect such a plan would have with regard to requirements of the following federal environmental laws, among others:

- Federal Water Pollution Control Act Amendments of 1972
- Clean Air Act (of 1970) and amendments
- Various legislation regarding noise, solid waste, and pesticides
- Historic Sites, Buildings, and Antiquities Act of 1935
- Endangered Species Act of 1973 and Endangered Species Conservation Act of 1969 and amendments
- Wetland Protection (Executive Order 11990)
- Floodplain Management (Executive Order 11988)

Because sludge is being considered for use on products that could reach the human and animal food chains, the expertise of the Food and Drug Administration and the Department of Agriculture will be solicited. All appropriate state standards and regulations will have to be met, including the Iowa Solid Waste Disposal Rules. These rules are administered by the Iowa Department of Environmental Quality (IDEQ).

The IDEQ must approve and permit all solid waste disposal site locations as well as locations for high-rate (greater than two tons per acre per year) land application of sludge including sludge storage sites and facilities. Land reclamation utilizing composted or digested sludge will also require an IDEQ permit.

Agency expertise and public opinion were sought for this project. The draft EIS will be distributed for review, and EPA will conduct public hearings to solicit additional information. This document is the draft EIS for the Des Moines ICA Sludge Management Plan.

CHAPTER II

AFFECTED ENVIRONMENT

INTRODUCTION

This section contains a description of the general setting for the project. The environmental and social areas covered are ones that might reasonably be expected to affect or be affected by this project or its alternatives.

The study area is comprised of several sites - the service area of the wastewater management system, the Des Moines Integrated Community Area (ICA), is an urbanized setting interspersed with medium density and rural uses between communities; the potential sludge application areas are largely rural; and the mine reclamation site is somewhat remote and isolated from public access. While most potential land application sites are within 25 miles of the Des Moines Main Plant, the mines are farther away to the southeast (approximately 40 miles).

The environmental setting for the proposed action comprises all of Polk and Warren counties (refer to Figure 5, page 42), with special emphasis given to two general areas determined in the 201 Study to have the highest potential for locating suitable land application sites. For the purpose of clarity, the two general areas are referred to as the "potential" land application areas, while Polk and Warren counties are considered the preferred land application limits owing to transportation costs and returning what is considered a benefit to the counties served by the wastewater treatment facilities. The general discussion of the region in this section is supplemented in Appendix A by descriptions of environmental settings in five specific sites, providing examples of possible landfilling, agricultural, and mine reclamation uses of anaerobically digested liquid and dewatered sludge. For these categories of sludge use potential, representative sites were selected - mainly by virtue of the interest expressed by the owner and/or operator of the site in the use of sludge - for detailed investigation of the environmental setting and probable impacts.

The representative sites serve to pinpoint the impacts which can be expected from sludge application and/or disposal to all areas of similar characteristics. For those areas which have very different characteristics, the impacts may vary widely. Therefore, it is important that, prior to drawing generalizations from assessments made here, one compare the environmental characteristics of the proposed sites with those of the representative sites. Clearly, some extrapolations and approximations will be possible in many cases; but, in some cases, it may be necessary to reevaluate the impacts and adjust application rates and management conditions to match the requirements of the particular site.

CLIMATE

The metropolitan Des Moines area, lying in the central region of Iowa, in the heart of North America, has a continental climate characterized by strong seasonal contrasts. During winters, large masses of cold, dry air move in from the polar region; during summers, warm, moist air from the Gulf of Mexico dominates the region. Occasionally, air masses from the Pacific Ocean move into central Iowa producing relatively mild, dry weather. Hot, dry winds from the southwestern desert region of the country occasionally bring desiccating conditions to the area (EPA, et al, 1977).

Temperature

The mean annual temperature for the city of Des Moines is 49.9° Fahrenheit (10° Celsius). Since sludge application may correspond to agricultural activities, it is convenient to separate the year into arbitrary seasons, corresponding to the growing seasons. The winter season, when most plant life is dormant, based on normal mean temperatures below 40° F, is about 19 weeks from mid-November to late March. The summer season, with mean daily temperatures of 60° F and above, lasts about 21 weeks from early May to early October. The spring and fall seasons, with mean daily temperatures in the range of 40°-59° F, each runs about six weeks.

Temperature extremes have been recorded from 110° F in July to -30° F in January (NOAA, 1980). Mean monthly temperatures for Des Moines are presented in Table 1.

Precipitation

Monthly precipitation data for Des Moines are provided in Table 1. Precipitation is moderate (average annual depth: 31.47 inches), with a large portion of the rain falling down from April through October.

Snowfall is also moderate, averaging about 33 inches per year, with heaviest accumulations occurring during the months of December through March.

Relative humidity generally stays between 60 percent of saturation (p.m. readings) and 80 percent (a.m. readings).

Winds and Storms

The mean monthly wind speed varies from slightly less than 9 miles per per hour during August to just more than 13 miles per hour in April. The prevailing direction is northwest from November through April and south from May through October. Winds at 15 feet above the ground reach 50 miles per hour (excluding gusts) about every other year and reach 75 miles per hour once in 50 years. (Mean monthly wind data are provided in Table 1.)

Approximately 75 percent of the 50 annual thunderstorms can be expected during the growing season (May-October). Tornado frequency is highest in May and June during afternoon and early evening hours (EPA, et al, 1977).

TOPOGRAPHY

The topography of the study area can be divided into two fairly distinct regions. The first includes the area north of the line of the Wis-

TABLE 1

TEMPERATURE, PRECIPITATION, SNOW, FREEZE, AND WIND DATA

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Temperature (°F)													
Mean	20.5	24.6	36.3	50.5	61.5	71.1	76.1	73.8	65.4	54.1	38.5	26.1	49.9
Maximum (Average)	29.2	33.5	45.5	60.7	71.7	81.1	86.5	84.1	76.0	64.7	47.6	34.2	59.6
Minimum (Average	11.7	15.7	27.1	40.2	51.3	61.1	65.7	63.4	54.8	43.4	29.3	18.0	40.1
Precipitation													
Inches (Average)	1.13	1.12	1.95	2.90	4.20	4.66	3.31	3.72	3.37	2.38	1.56	1.17	31.47
Snowfall													
Inches (Average)	8.5	7.2	6.8	1.7	Trace	0	0	0	Trace	0.3	2.6	6.3	33.4
Freeze*													
Mean number of days with minimum temperature ≤32°	30	27	21	6	<0.5	0	0	0	<0.5	5	18	29	136
Wind													
Mean Speed (mph)	11.7	11.7	13.0	13.1	11.4	10.4	9.0	8.8	9.4	10.5	11.5	11.5	11.0
Direction	NW	NW	NW	NW	SE	S	S	S	S	S	NW	NW	NW

*19 years recorded data

SOURCE: National Oceanic and Atmospheric Administration, (years of record 1980) consin glacial advance and encompasses approximately three fourths of the Des Moines Integrated Community Area (ICA). The land is relatively rolling and undulating. The land forms are primarily glacial, and the surface is in extreme youth with respect to erosion and drainage patterns. In this northern region, the drainage conforms to the hills; it does not form them. The area is termed the Des Moines Lobe. The second region, the area south of the glacial line, is rough and hilly. It is this area in which the major portion of the land considered for sludge application is situated. The landscape is in early maturity with respect to erosion and drainage patterns. The land forms are clearly those resultant of stream action. This area is known as the Southern Iowa Drift Plain.

Significant surficial features within the ICA include the Des Moines and Raccoon rivers. Within the areas considered for sludge disposal are the Spring, Mud, and Camp creeks (found in the northern sludge disposal area) and the Middle and South rivers and Butcher and Turkey creeks (located in the southern disposal area). With the exception of Turkey Creek, which is tributary to the South River, all other rivers and creeks are tributary to the Des Moines River. The flood pool of Red Rock Reservoir extends into the southern sludge disposal area and also lies between the two general areas considered for sludge application.

GEOLOGY

The surficial layer of substrate is fairly uniform over the study area. It consists of loess and glacial and river deposits laid down during the Pleistocene epoch. This material may attain depths of several hundred feet. South of the limits of the Wisconsin ice sheet, a thick veneer of loess covers the uplands. A layer of loess may be found under the Wisconsin structures in certain places to the north (EPA, et al, 1977).

Underlying the Des Moines ICA, both land application areas and part of the land reclamation site are bedrock of the Cherokee and Maramaton groups in the Pennsylvania system. The Cherokee group is typified by cyclic deposits of carbonaceous shale, clay, siltstone, sandstone, and coal beds. Minor limestone beds and parts of the Atoka and Morrow series may be included in the area. Bedrock of the Maramaton group is scattered throughout the study areas with alternating layers of shale and limestone with some sandstone and coal (Cagle, et al, 1978).

Part of the land reclamation site lies above bedrock of the Meramec Series. This series is mostly limestone (St. Genevieve and St. Louis), with some red and green shale, sandstone, and dolomite (Cagle, et al, 1978).

SOILS

Soils in the study area have been surveyed by the U.S. Soil Conservation Service (SCS). Final reports on the detailed soil surveys have been acquired for Polk, Warren, and Marion counties, the locations of the two potential land application areas and the mine reclamation sites, respectively. The soils in the study area are generally highly productive agricultural soils of Class I or II capability (EPA, et al, 1977). Soils are grouped into associations. The typical characteristics of these associations are detailed for the study areas in the following paragraphs. Once specific land application sites have been identified, an in-depth analysis will be possible.

Polk County Potential Land Application Area Soils

The potential land application area in Polk County contains three general soil associations. The largest, covering approximately 50 percent of the area, is the Downs-Fayette (EPA, et al, 1977). This association is roughly 45 percent Downs soils, 25 percent Fayette soils, and 30 percent soils of minor extent. Downs soils are nearly level to moderately steep with a very dark brown silty loam surface layer of seven inches. The subsurface layer is a dark grayish-brown loam about five inches thick. Drainage is generally very good. Fayette soils are gently sloping to steep with a very dark brown silt loam surface layer four inches thick. The subsurface is a dark grayish-brown silt loam about seven inches thick. Drainage is again typically good. Downs-Fayette association soils are best suited for hay, pasture, or woodlands. Soil management must control water erosion and maintain tilth (USDA, 1978).

Located in the northern side and comprising roughly 30 percent of the study area is the second general soil association, Tama and Muscatine (USDA, 1960). This association is approximately 80 percent Tama, 7 percent Muscatine, and 13 percent soils of minor extent. Tama soils are nearly level to strongly sloping and well drained. They have a very dark brown silty clay surface layer of 13 inches. Muscatine soils are typically nearly level and poorly drained. The surface layer is similar to Tama, although thicker. Tama-Muscatine soils are well suited for cultivated crops and are among the most productive soils in the county. The main concern of management is controlling water erosion (USDA, 1978).

The third general soil association borders the Des Moines River and covers roughly 20 percent of the potential land application area. The association is comprised of four soil series: Colo, Waukegan, Dickenson, and Dorchester (USDA, 1960). The association is typically nearly level and formed from outwash and alluvium. Colo soils are nearly level to gently sloped and poorly drained. The surface layer is black silty clay loam approximately 25 inches thick. The subsurface layer is a very dark gray silty clay loam that extends to a depth of 40 inches (USDA, 1978). The Waukegan series is a level to slightly sloped well drained soil. The surface layer is dark colored and underlain with coarse sand and fine gravel (USDA, 1960). They have a dark grayish-brown loam to sandy loam surface layer of 24 to 60 inches (USDA, 1960). The final series in this association are Dorchester soils. Typically, they are a nearly level, recently deposited bottomland soil (USDA, 1960). As a whole, the association is fairly productive, often planted in corn or soybean, used as pasture, or left as woodland. Management concerns are water erosion and flood control (USDA, 1978).

Warren County Potential Land Application Area Soils

The land application area under study in Warren County is also composed of three general soil associations, each approximately equal in acreage. Along the Des Moines River, the soil is of the Zook-Wabash-Nodaway association. Typically, the land is nearly level and very poorly to moderately well drained (USDA, 1978). Zook soils comprise roughly 33 percent of the association, with Wabash accounting for 10 percent, Nodaway 10 percent, and soils of minor extent the remaining 47 percent. Zook soils are nearly level and poorly drained. The surface layer is roughly 36 inches thick; the upper part is black silty clay loam, and the lower part is black silty clay. Wabash soils are also nearly level and very poorly drained. The surface layer is similar to Zook soils. Nodaway soils are nearly level and moderately well drained. Their surface layer is a very dark grayish-brown silt loam about five inches thick. Soils of this association are used for intensive row cropping with some areas used for pasture. The main concern in management is the control of flooding and the improvement of drainage (USDA, 1978).

Located in three groups in the study area, the second association is of the Downs-Fayette series. Typically, Downs-Fayette soils are nearly level to steeply sloped and well drained (USDA, 1978). This association has been further detailed for the Polk County area.

The third general soil association is of the Tama series. This series is of nearly level to strongly sloping, well drained soils (USDA, 1978). Again, this association was detailed for Polk County.

Marion County Land Reclamation Site Soils

Mine spoil sites are primarily composed of carbonaceous shale crushed into small stone. Areas of topsoil laid back during mining operations dot the site. The topsoil is mixed with spoil; there was apparently no effort made to segregate or replace it. The pH of spoil is typically 3 to 5, with areas mixed with topsoil of pH 5 to 7.

WATER

Even though sludge handling is an important phase of the total water management picture in the Des Moines region, it neither demands nor supplies significant quantities of water to the total system. However, sludge must be viewed as a potential threat to the quality of waters, both in the ground and on the surface. Therefore, the discussion that follows is not aimed at being a comprehensive elucidation of the water supplies of the region; rather, it is meant to provide the basic background for the impact statements which are presented in subsequent sections.

Surface Water

The water quality data for the ICA's rivers and streams during optimum flow generally indicate good water quality with respect to dissolved oxygen (DO), pH, biochemical oxygen demand (BOD), orthophosphates ($PO_4^{\equiv}$), and temperature. Iowa water quality standards are violated periodically, primarily in winter or during low flow conditions, and consist of violations of coliform bacteria levels, dissolved oxygen, and ammonia (NH_4^+) downstream of municipalities which discharge wastewater. Ammonia violations are the most frequent. Dissolved oxygen levels in the Des Moines River have improved over the years, although violations still occur during low flow conditions. Fecal coliforms frequently exceed EPA guidelines throughout the study area largely because of nonpoint sources.

Pesticides, such as DDE and dieldrin, have been detected in higher than recommended concentrations in study area streams. Turbidity during periods of runoff also has been severe. The temperature level in the Lower Des Moines River is a potential problem as well. Although phosphorus and nitrogen concentrations are high enough to produce algal growth, other factors, such as light penetration, temperature, or other trace nutrients, mitigate such problems.

The water quality of the Raccoon River has violated dissolved oxygen, ammonia, fecal coliforms, DDE, and dieldrin levels. These violations have particularly occurred during winter and low flow conditions.

Water quality data for surface waters within the two general areas considered for sludge application are limited to the Middle and South rivers which join the Des Moines River in northeastern Warren County.

Much of the lower reach of the Middle River has been dredged and is of minor importance for fishing (Harlan, et al, 1969). It has been designated as a Class B stream from its mouth to the Adair-Guthrie county line (Kennedy, et al, 1980). Class B streams are those protected for wildlife, aquatic life, semiaquatic life, and secondary body contact uses. Surveys conducted during August and September, 1980, when stream flows are expected to be lowest, indicate generally good water quality with respect to dissolved oxygen, BOD, NH_4^+, and nitrate (NO_3^-). Selected data are listed in Table 2.

Like the Middle River, the lower reach of the South River has also been dredged and is of limited fishing importance (Harlan, et al, 1969). A review of the data presented in Table 3 indicates overall good water quality as typified by the low ammonia-nitrogen, low filtrable phosphate, low BOD, and high dissolved oxygen levels.

For the other streams within the potential sludge application areas, namely Butcher, Spring, Mud, Camp, and Turkey creeks, no water quality data are available. However, a small amount of water quality data on other creeks (Beaver, Walnut, and Yeader) within the study area is believed to be representative. In these streams, turbidity has been a problem, largely because of runoff. Dissolved oxygen concentrations are usually well above Iowa stream standards; yet fecal coliform levels have been found to exceed the EPA guideline of 200/100 milliters (Donahue, et al, 1981).

Groundwater

Groundwater is an important source of potable water in the study areas. The city of Des Moines obtains water from the shallow sand and grav-

TABLE 2

SELECTED DATA FROM THE MIDDLE RIVER
8 SEPTEMBER 1980
(all values in mg/l unless specified otherwise)

Station	Flow[1]	Specific Conductance[2]	Ammonia-Nitrogen	Nitrate-Nitrogen	Filtrable Phosphate	DO	BOD	Turbidity[3]	TOC[4]
1. Middle River	1.7	480	0.10	0.9	0.11	8.5	3	4.4	9
2. Middle River	3.6	360	0.03	<0.1	0.07	8.5	6	12.0	15
3. Middle River	5.6	360	0.03	<0.1	0.04	11.9	9	27.0	15
Winterset WWTP	0.65	--	4.00[+]	--	--	4.9	35[++]	--	--
4. Middle River	6.2	480	0.22	0.5	0.76	14.1	11	20	21
5. Middle River	13.0	430	0.01	<0.1	0.16	8.9	11	30	23
6. Clanton Creek	1.7	430	0.02	<0.1	0.08	13.3	9	27	15
7. Middle River	15.0	450	0.02	<0.1	0.13	8.7	9	30	20
8. Middle River	17.0	460	0.03	<0.1	0.15	9.3	9	27	21
9. Middle River	18.0	480	0.02	<0.1	0.13	8.1	8	22	18
10. Middle River*	21.0	490	0.02	<0.1	0.13	8.5	8	23	16
11. Middle River*	28.0	500	0.03	<0.1	0.19	11.3	8	26	19

[1] Cubic feet per second
[2] Micromhos per cm @ 25° C
[3] Nephelometric Turbidity Units
[4] Total Organic Carbon

*Sampling stations within or near considered sludge application area
+Exceeds 2 mg/l standard
++WWTP effluent does not meet 30-day BOD average standard of 30 mg/l

SOURCE: Kennedy, et al, 1980

TABLE 3

SELECTED DATA FROM THE SOUTH RIVER
9 SEPTEMBER 1980
(all values in mg/l unless specified otherwise)

Station	Flow[1]	Specific Conductance[2]	Ammonia-Nitrogen	Nitrate-Nitrogen	Filtrable Phosphate	DO	BOD	Turbidity[3]	TOC[4]
1. South River	0.04	280	0.05	0.6	0.15	10.1	6	60	20
2. South River	1.60	410	0.15	0.6	0.14	10.2	2	65	12
New Virginia WWTP	0.03	--	6.3+	--	--	18.3	85++	--	--
3. Squaw Creek	1.5	460	0.06	0.1	0.11	10.9	2	22	12
4. Squaw Creek	2.3	430	<0.01	0.1	0.12	11.4	2	13	11
5. South River	5.2	410	0.03	0.3	0.12	11.5	2	28	13
Indianola WWTP	0.58	--	0.13	--	--	6.9	4	--	--
6. South River	6.6	480	0.07	1.2	0.60	10.2	3	24	10
7. Otter Creek	3.0	330	0.04	0.8	0.13	11.1	2	50	14
8. South River*	13.0	410	0.02	0.7	0.28	11.6	3	39	17
9. South River*	18.0	390	<0.01	0.5	0.17	13.8	4	45	13

[1] Cubic feet per second
[2] Micromhos per cm @ 25° C
[3] Nephelometric Turbidity Units
[4] Total Organic Carbon

*Sampling stations within or near considered sludge application area
+Exceeds 2 mg/l standard
++WWTP effluent does not meet 30-day BOD average standard of 30 mg/l

SOURCE: Kennedy, et al, 1980

el alluvial (surface) aquifer of the Raccoon River. Nearly 100 other cities and communities in central Iowa also draw water from shallow aquifers. A number of other cities, including West Des Moines, Altoona, Granger, and Waukee, pump water from bedrock aquifers (EPA, et al, 1977).

The study areas are underlain by several aquifers. The uppermost shallow alluvial or surface aquifer is composed of unconsolidated deposits at or near the land surface. Below the alluvial aquifer is a sequence of consolidated sedimentary rocks (bedrock). Some of these rocks are water yielding aquifers, while some are confining beds and do not yield water to wells. The major bedrock aquifers in the area are the Mississipian, the Devonian, and the Cambrian-Ordovician. Local aquifers of sandstone and limestone occur in the Pennsylvania rocks. Figure 1 shows the arrangement of aquifers in the areas (Cagle, et al, 1978).

The surface alluvial aquifers are the groundwaters of concern in land application and land reclamation sites. As noted, these aquifers lie at or near the surface of the land. Test well data for the Polk County land application area indicate the water table lies at an elevation of roughly 900 feet, sloping down to 700 feet near the Des Moines River. Streams in the area cause the water table to drop locally. The depth to the water table varies with the land surface topography. Test well depths range from as little as 7 to nearly 150 feet. Similar groundwater data for the Warren County land application area and the Marion County land reclamation site are not available. However, similar elevations and depths can be expected.

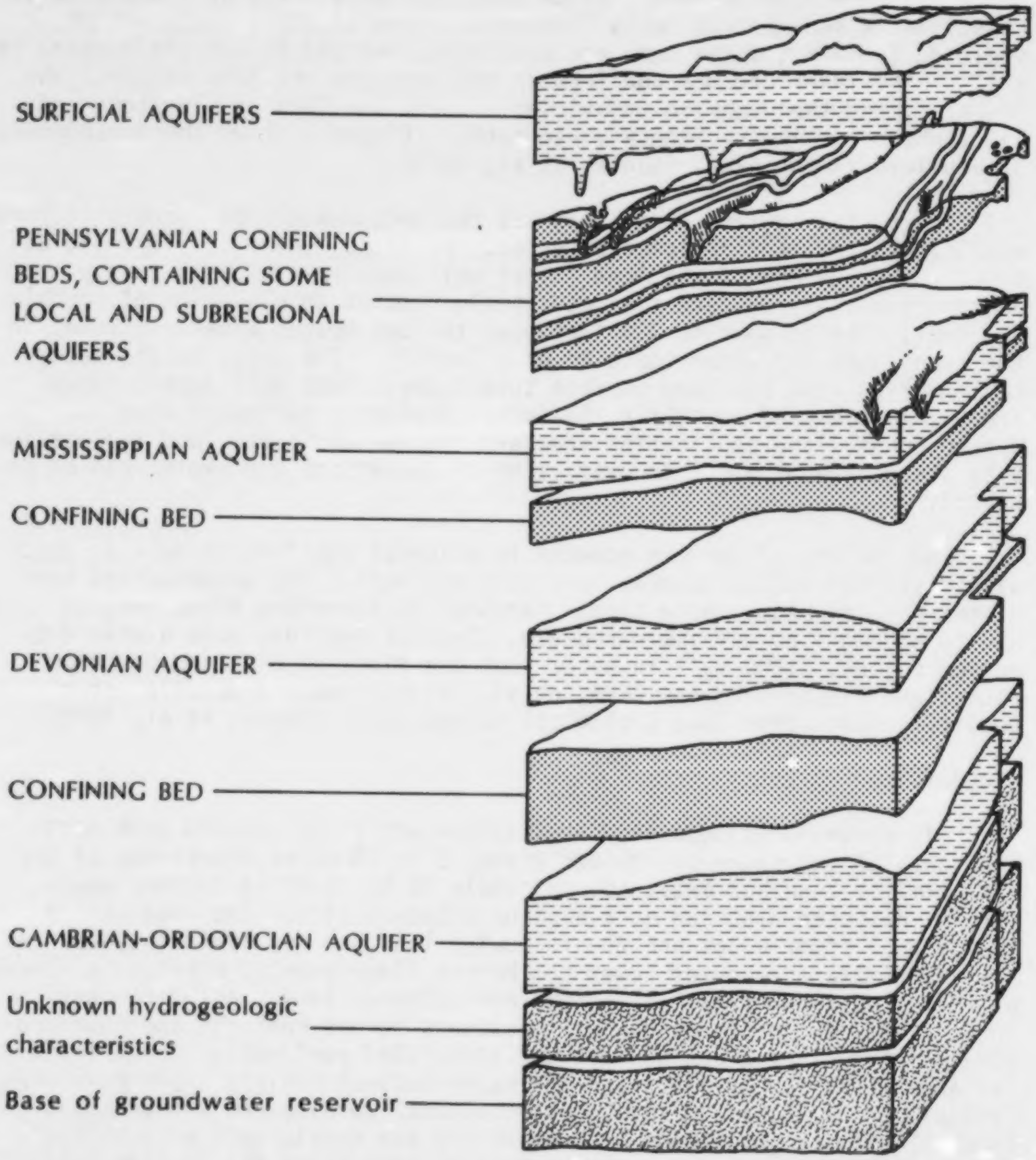
The quality of the groundwater in alluvial aquifers is fair to good, with dissolved solids usually less than 500 mg/l. The groundwaters are of the calcium bicarbonate type. Hardness is therefore high, ranging from 250 to 500 mg/l as calcium carbonate. Bedrock aquifers have higher dissolved solids, 2,500 mg/l in water from the Mississippian and Devonian rocks, and higher hardness (EPA, et al, 1977). Table 4 details water quality results from Iowa Geological Survey tests (Cagle, et al, 1978).

BIOLOGY

The potential sludge land application areas are located both north and south of the Lower Des Moines River, 5 to 15 miles downstream of the city limits. Another area, approximately 30 to 35 miles further downstream, has been proposed as a back-up disposal site. Included within the overall study areas are the following land use and habitat types: a ten river-mile stretch of Lower Des Moines River aquatic habitat; a floodplain and wetlands riparian system; agricultural land, including cultivated fields and pasture; eastern deciduous forest habitat; and four medium-to-low density urban centers and associated residential communities. The area is basically flat, and the major natural habitat types have been partitioned and modified through agricultural development and urbanization. The important issues to consider in the development of a biological profile of this area are the potential effects of the further habitat partitioning, habitat modifications and displacement, and water and soil contamination.

FIGURE 1

AQUIFERS OF CENTRAL IOWA


SURFICIAL AQUIFERS
PENNSYLVANIAN CONFINING BEDS, CONTAINING SOME LOCAL AND SUBREGIONAL AQUIFERS
MISSISSIPPIAN AQUIFER
CONFINING BED
DEVONIAN AQUIFER
CONFINING BED
CAMBRIAN-ORDOVICIAN AQUIFER
Unknown hydrogeologic characteristics
Base of groundwater reservoir

Redrawn from Iowa Geological Survey Water Atlas Number 5, Water Resources of South-Central Iowa, State of Iowa, 1978.

TABLE 4

CHEMICAL CHARACTERISTICS OF WATER FROM AQUIFERS
(results in milligrams per liter)

Average (A) and range (R)	Dissolved solids	Hardness (as CaCO$_3$)	Sulfate (SO$_4$)	Chloride (Cl)	Fluoride (F)	Nitrate (NO$_3$)	Sodium (Na)	Iron (Fe)	Manganese (Mn)	Number of analyses
Alluvial aquifer										
A	417	288	105	13	0.3	4.2	20.2	9.4	1.5	56
R	165-1000	124-762	3-350	0.5-180	0.1-0.45	0.1-17	4.1-85	0.04-51	0.05-17	
Shallow drift aquifer										
A	736	480	177	37	0.3	81+	68	1.1	0.13	95
R	220-2840	153-1710	12-1470	0.5-200	0.2-0.8	0.1-570	7.3-710	0.02-30	0.05-1.9	
Intermediate drift aquifer										
A	1030	569	397	9	0.5	6	108	5	0.09	23
R	261-2726	150-1518	7-1520	0.5-49	0.2-1.0	0-44	17-368	0.04-24	0.05-0.37	
Deep drift and Buried-channel aquifers										
A	2346	868	1254	30	0.6	6.7	334	3.4	0.24	15
R	383-3657	140-1640	42-1990	3-110	0.1-2.0	0-82	54-568	0-18	0-1.4	
Pennsylvanian (Cherokee Group) aquifers										
A	4531	869	1088	97	1.4	3.5	536	3.2	0.15	85
R	251-7092	44-1559	22-4139	0.5-780	0.2-4.0	0-50	7-2180	0.1-22	0-4	
Mississippian aquifer										
Upper part of Mississippian aquifer in Marion County where aquifer is bedrock surface										
A	674	449	217	48	0.24	•	43	2.2	0.12	9
R	422-1380	108-952	27-563	2-32	0.2-0.4	0.1-4.3	8.8-240	0.2-9.8	0.05-0.25	
Upper part of Mississippian aquifer in Marion County where overlain by Pennsylvanian rocks										
A	2826	862	1493	109	1.3	1.6	492	6.6	0.06	18
R	368-6500	124-1660	49-3480	1-492	0-2.4	0.1-7.1	6.8-1480	0.1-45	0-0.12	
Lower part of Mississippian aquifer in Marion County where overlain by upper part of aquifer										
A	3320	1004	1856	89	0.93	15.4	626	4.1	0.23	8
R	1189-4990	731-1159	582-3065	9-230	0-2.8	0.04-32	28-1091	0.18-25	0-1.3	
Mississippian aquifer in area outside Marion County										
A	4274	923	2385	176	1.9	8.4	965	7.6	0.11	29
R	1210-8400	60-1580	521-4500	19-750	1.0-3.6	0-150	270-2100	0.05-23	0-0.34	
Cambrian-Ordovician aquifer										
A	1098	370	397	150	2.3	1.2	226	2.4	0.05	22
R	614-2560	246-1100	190-930	29-620	1.2-3.2	0.08-5.5	100-520	0.04-10	0.01-0.10	

+Does not meet federal drinking water standard of 10 mg/l as N (33 mg/l as NO$_3$)
SOURCE: Cagle, et al, 1978

Aquatic and Riparian Habitat

The Lower Des Moines River supports a community of fish populations common to aquatic systems of relatively low dissolved oxygen levels. Representative species include carp, river carpsucker, black crappie, black bullhead, big-mouth buffalo, and channel catfish. The benthic invertebrate community comprises such species as caddis flies, mayflies, mosquitoes, stoneflies, crayfish, dragonflies, and damsel flies. Very little rooted aquatic vegetation is established in this area. Seasonally fluctuating populations of phytoplankters represent the dominant primary producers.

The floodplain of the aquatic system stretches as far as 2-1/2 to 3 miles south of the river and as far as 2 miles north of it. The wetlands of this zone are largely ephemeral, occurring on a seasonal basis, and are dominated by cattail, arrowhead, sedges, and rushes. The forested wetlands are characterized by the occurrence of willows, sycamore, and cottonwood. Beaver, muskrat, and mink are common to these wetland systems as are various duck species, including mallards, teals, wood ducks, and lesser scaup. Migratory waterfowl also occur in these freshwater marsh systems seasonally.

The potential Polk County disposal area includes a 350-acre, state managed, freshwater wetland system.

Agricultural Lands and Soil Microbiology

The study area is characterized by considerable agricultural activity. A substantial portion (more than 60 percent) of the study area is cropland and pasture. The heavy agricultural development of the area has had a profound influence on soil properties. The use of fertilizers, herbicides, and pesticides affects not only soil composition but microbial populations as well. Land application of sludge can also be expected to affect soil microbe populations.

The microbial community, which includes bacteria, actinomycetes, fungialgae, and protozoa, carries out several functions which influence the capacity of a given area to accommodate applications of sludge. Among these functions are nitrogen fixation, biodegradation of complex organic compounds, and the conversion of nutrient elements to organic matter. The composition of the microbial community, and the associated efficiency with which the biochemical reactions occur in the soil, can be influenced by soil pH, temperature, moisture, aeration, chemical composition, and population dynamics and ecological relationships (predator/prey, symbiosis, etc.) among the species within the community.

Forest

The study area occurs at the approximate western edge of the Eastern Deciduous Forest Habitat. There is no expansive forest ecosystem stretching across the study area; rather, habitat patches, dominated by oak-hickory associations in the uplands and by ash, willow, and cottonwood along the floodplain, occur scattered throughout the area. Squirrel, deer, fox, and raccoon occur commonly within these patchy systems as do toads, owls, and vultures. At the forest edge bordering meadowlands, rabbits, quail, pheasant, gopher, and vole are common.

Urban/Residential

Four low-to-medium density communities occur within the study area. North of the river are Mitchellville and Runnells; and south of the river are Hartford and Carlisle. Other low density residential areas occur through the study area.

Rare and Endangered Species

The federal endangered species list includes two species known to occur in the vicinity of the study area: the Indiana bat and the peregrine falcon. Table 5 lists those species found in south-central Iowa considered by the Iowa State Conservation Commission to be endangered or threatened.

AIR QUALITY

Under the federal Clean Air Act, national primary and secondary ambient air quality standards were promulgated to define levels of air quality which are necessary to protect the public health and welfare from any known or anticipated adverse effects of air pollutants. Pollutants for which such standards have been promulgated include sulfur dioxide (SO_2), particulate matter (PM), carbon monoxide (CO), ozone (O_3), hydrocarbons (HC), nitrogen dioxide (NO_2), and lead (Pb). Areas which meet these standards are considered attainment areas, while those failing to meet the standards are said to be in nonattainment.

Currently, the entire study area is classified as attainment of primary and secondary SO_2, NO_2, O_3, HC, and Pb standards. Carbon monoxide and suspended particulates, however, do present a problem in certain areas. Areas of nonattainment for CO include Des Moines and Lee townships based on violations monitored in downtown Des Moines. Areas of nonattainment for suspended particulates include a small area in Ankeny, downtown Des Moines, a small area east of the Des Moines airport, and a large area northwest of the airport (Donahue, et al, 1981, and IDEQ, 1981). The major sources of these pollutants are motor vehicles and fossil fuel-burning power plants (EPA, et al, 1977).

Within the two potential areas considered for sludge application, no violations of air quality standards have been noted, although fugitive dust from unpaved roads and other heavily used unpaved areas have caused problems (EPA, et al, 1977).

Odors

Background odors generally associated with the study area are those normally associated with urban, suburban, and farming communities. The

TABLE 5

ENDANGERED AND THREATENED IOWA VASCULAR PLANTS AND ANIMALS
SOUTH CENTRAL REGION

VASCULAR PLANTS (by habitat)

PRAIRIE

Common Name	Latin Name	Status
Mead's Milkweed	Ascelepias Meadil	Endangered
Rice Button Aster	Aster dumosis	Presumed extirpated
Yellow Wild Indigo	Batrisia tinctoria	Presumed extirpated
Bunchflower	Veratrum virginicum	Threatened
	Verbascum lychnitis	Presumed extirpated
Kitten-Tails	Wulfenia bulii	Endangered

WETLANDS

Common Name	Latin Name	Status
White Lady Slipper	Cypripedium candidum	Threatened
Vasey's Pondweed	Potamogeton vaseyi	Threatened

WOODLAND

Common Name	Latin Name	Status
Black Haw	Viburnum prunifolium	Undetermined

Definitions

Endangered	A species or subspecies of a native Iowa vascular plant which is in danger of becoming extirpated if no action is taken. Generally known from three or fewer stations.
Extirpated	Formerly occurred as a native, reproducing population in Iowa but is no longer found there. Still found in other states.
Threatened	A species or subspecies of native Iowa vascular plant which is likely to become endangered if conditions worsen and no action is taken. Very limited distribution and is of concern.
Undetermined	Insufficient information has been compiled to make an evaluation of its status, but is of concern.

TABLE 5 (continued)

Common Name	Status
Black-billed Cuckoo	Undetermined
Barn Owl	Endangered
Long-eared Owl	Threatened
Burrowing Owl	Endangered
Say's Phoeba	Threatened
Loggerhead Shrike	Threatened
Bell's Vireo	Undetermined
Blue-winged Warbler	Threatened
Yellow Warbler	Undetermined
Stinkpot	Threatened
Illinois Mud Turtle	Endangered
Wood Turtle	Endangered
Ornate Box Turtle	Threatened
Red-eared Turtle	Threatened
Blandings Turtle	Threatened
Five-lined Skink	Threatened
Great Plains Skink	Endangered
Western Slender Grass Lizard	Endangered
Diamondback Water Snake	Threatened
Yellow-bellied Water Snake	Threatened
Granham's Water Snake	Threatened
Western Earth Snake	Threatened
Black Rat Snake	Threatened
Speckled Kingsnake	Endangered
Northern Copperhead	Endangered
Massasauga	Threatened
Prairie Rattlesnake	Endangered
Small-mouthed Salamander	Threatened
Blue-spotted Salamander	Endangered
Central Newt	Endangered
Plains Spadefoot	Threatened
Spring Peeper	Threatened
Chestnut Lamprey	Threatened
American Brook Lamprey	Threatened
Lake Sturgeon	Endangered
Pallid Sturgeon	Endangered
Alabama Shad	Extirpated
Skipjack Herring	Threatened
Grass Peckerel	Threatened
Redside Dace	Extirpated
Southern Redbelly Dace	Undetermined
Sturgeon Chub	Extirpated
Sicklefin Chub	Endangered
Lake Chub	Endangered
Gravel Chub	Threatened
Pugnose Shiner	Threatened
Ironcolor Shiner	Extirpated
Blacknose Shiner	Endangered
Weed Shiner	Threatened

TABLE 5 (continued)

ANIMALS, FISH, BIRDS

Common Name	Status
Pygmy Shrew	Undetermined
Least Shrew	Undetermined
Keen's Myotis	Threatened
Indiana Bat	Endangered
Evening Bat	Threatened
Big Free-tailed Bat	Extirpated
Plains Pocket Mouse	Endangered
Grasshopper Mouse	Endangered
Red-backed Vole	Endangered
Pine Vole	Endangered
Porcupine	Extirpated
Gray Wolf	Extirpated
Black Bear	Endangered
Fisher	Extirpated
Ermine	Undetermined
Long-tailed Weasel	Undetermined
Wolverine	Extirpated
Spotted Skunk	Undetermined
River Otto	Threatened
Mountain Lion	Extirpated
Lynx	Extirpated
Bobcat	Endangered
American Elk	Extirpated
Bison	Extirpated
Pronghorn Antelope	Extirpated
Eared Grebe	Threatened
Trumpter Swan	Extirpated
Swallow-tailed Kite	Extirpated
Sharp-shinned Hawk	Extirpated
Cooper's Hawk	Threatened
Red-shouldered Hawk	Endangered
Broad-winged Hawk	Threatened
Bald Eagle	Extirpated
Northern Harrier	Endangered
Peregrine Falcon	Endangered
Greater Prairie Chicken	Extirpated
Sharp-tailed Grouse	Extirpated
Whooping Crane	Extirpated
Piping Plover	Endangered
Long-billed Curlew	Extirpated
Upland Sandpiper	Endangered
Least Tern	Endangered
Passenger Pigeon	Extinct
Carolina Paroquet	Extinct

TABLE 5 (continued)

Common Name	Status
Silverband	Endangered
Topeka Shiner	Threatened
Pugnose Minnow	Undetermined
Pearl Dace	Endangered
Lake Chubsucker	Extirpated
River Redhorse	Extirpated
Black Redhorse	Endangered
Starhead Topminnow	Endangered
Plains Topminnow	Endangered
Longear Sunfish	Endangered
Crystal Darter	Undetermined
Western Sand Darter	Threatened
Mud Darter	Threatened
Bluntnose Darter	Threatened
Least Darter	Endangered
Orangethroat Darter	Endangered
Gilt Darter	Extirpated
Pirate Perch	Undetermined

Definitions

Extinct	A species no longer found anywhere on Earth.
Extirpated	A species or subspecies which once existed in Iowa but is no longer found in the state. It may be found in other states.
Endangered	A species or subspecies in danger of becoming extirpated in Iowa in the foreseeable future if its environment worsens and no management steps are taken.
Threatened	A species or subspecies that may become endangered in the foreseeable future if its environment worsens and no management steps are taken.
Undetermined	A species or subspecies known to exist in Iowa in low numbers and is of concern but of which there is insufficient information to make an accurate decision on its status.

SOURCE: State Conservation Commission, 1977 and 1979.

soybean processing and meat packing and rendering plants on the southeast side of Des Moines emit characteristic odors which are especially noticeable at distant locations during calm periods when mixing with the upper air layers is minimal. Other odorous materials are those commonly associated with farming operations. These fertilizer and manure odors are generally accepted as part of normal farm operations and are, therefore, tolerated.

Odors are regulated to a certain degree by Chapters 4 and 14 of Iowa Rules and Regulations relating to air pollution control. Regulation of odors associated with sludge management practices, however, are limited to a response-to-complaint basis as set forth in Chapter 14 of the above referenced regulations. No air emission permits associated with odorous air contaminants will be required for the considered sludge handling alternatives.

NOISE

Information on existing and projected noise levels is only available in connection with specific highway construction projects as well as the Des Moines Municipal Airport Master Plan. Noise-generating land uses in the study area include interstate highways and other motor vehicular traffic thoroughfares, concentrations of streets as found in downtown Des Moines and selected outlying areas, railroad switching yards, the airport, and industrial plants which produce heavy equipment. Within the considered potential sludge application areas, one would expect relatively low noise levels associated with a rural setting punctuated by the sounds of farm equipment and occasional motor vehicles.

LAND USE

Areas in the proximity of the proposed project presently contain a variety of urban and rural land uses. Those areas which are generally urban include land in the vicinity of the Main Des Moines Wastewater Treatment Plant, although the land immediately adjacent to the plant is vacant. Areas which are rural include the two general sites considered for sludge application.

The Des Moines Main Plant, which will house the sludge processing (e.g., dissolved air flotation thickeners, anaerobic digesters, and sludge dewatering) equipment and transport loading facilities, is located on the southeast side of Des Moines adjacent to the Des Moines River. Medium density residential uses are found within 0.25 miles to the east, and a high density residential area is situated approximately 0.20 miles northwest of the plant. Vacant land and industrial uses are immediately adjacent to the plant.

The two potential areas considered for sludge application are rural in character. While low woodlands are found along stream banks and on steeper slopes, the majority of land is under cultivation, planted to corn or soybeans. Some pasture lands are also present. The potential land application area located in Polk County contains no hamlets or incorporated towns.

Dwelling units are scattered along highways and section line roads, seldom exceeding a density of more than ten dwellings per square mile.

The potential sludge application area under consideration in Warren County is similar to that in Polk County, although one small hamlet, Palmyra, and one incorporated city, Hartford, are found there. Existing land use in the 208 area is shown in Figure 2.

Future land use within the potential sludge application areas is expected to remain in agricultural uses. With the exceptions of Palmyra and Hartford, all lands are zoned either A-1, Agricultural Districts, or Floodplain and Conservation Districts.

Future land use shown in Figure 3 reflects the Preliminary Intensity Development Pattern developed by CIRALG based upon the comprehensive plans of the individual governmental units within the 208 study area.

Of the 26 local governmental jurisdictions within the 208 study area, 20 have comprehensive plans and zoning ordinances representing official statements of policy for future growth and development (CIRALG, et al, January, 1976). The comprehensive plans and zoning ordinances most likely affecting solids management in the ICA include these for Warren, Polk, and Marion counties. A more detailed discussion regarding land use plans and zoning requirements is presented in the "Land Use and Land Use Plans" section in Chapter IV.

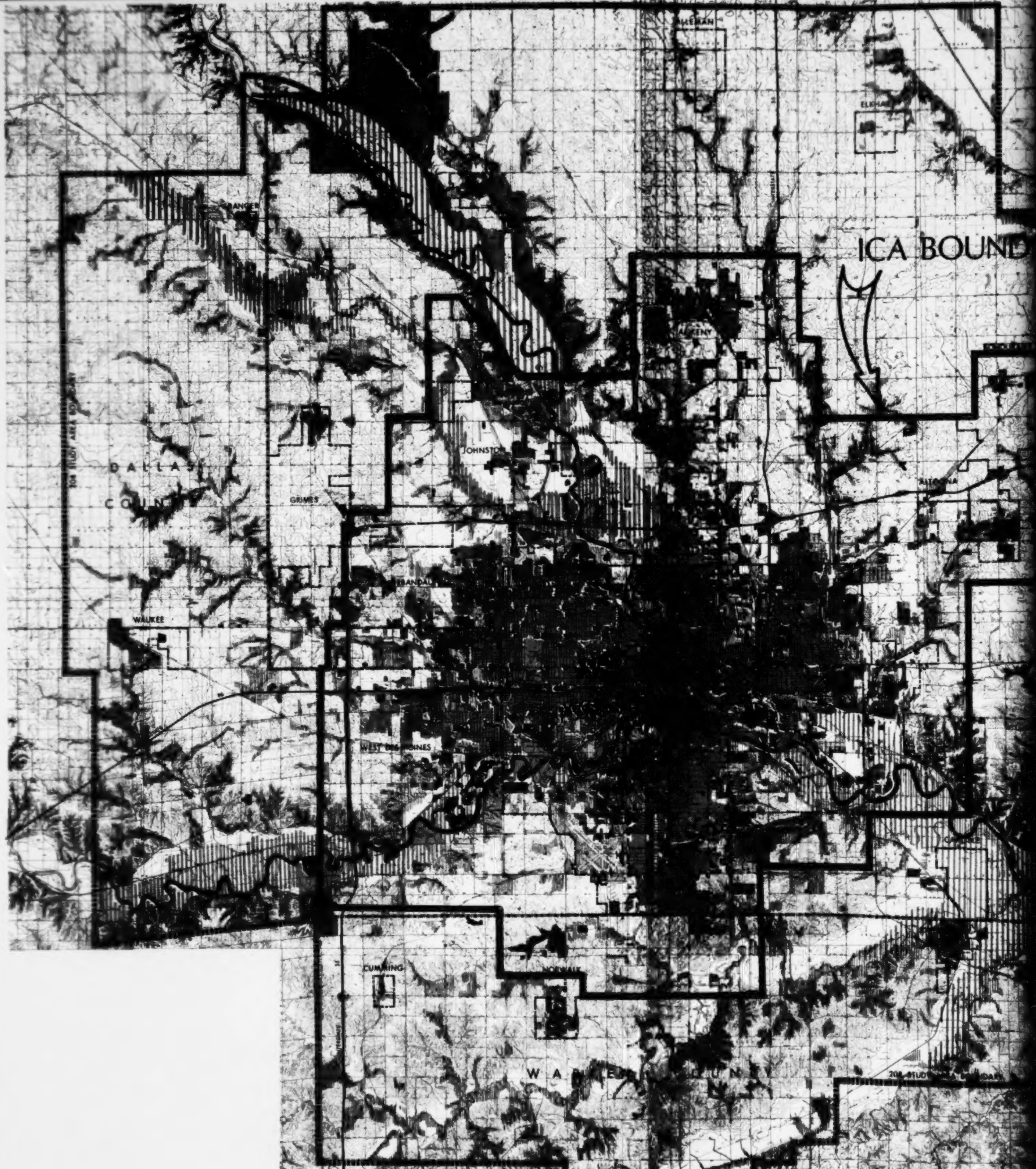
LAND TENURE

The Des Moines Main Plant is situated on publicly owned lands. Land application sites, as well as sites for interim sludge storage facilities, are privately owned. As presently planned, land application sites will remain in private ownership. Planning for interim sludge storage facilities has not progressed to the point where future land ownerships can be determined. Transportation of sludge from the treatment facility to disposal sites will occur along existing roads or rail lines.

POPULATION

Des Moines ICA Population

In common with major metropolitan areas throughout the country, there has been a shift in population from the central city to the suburbs. Between 1970 and 1980, Des Moines experienced a 5.2 percent decline in population, while all other ICA communities (except Windsor Heights) witnessed significant growth ranging from 28.8 to over 1,000 percent. Windsor Heights saw a decline of 10.6 percent. This compares with an overall population growth in Polk County of 6 percent. The 1980 population of the ICA was 290,828. Table 6 summarizes growth trends for ICA communities over the past decade.


ALLEMAN
ELKHAR
ICA BOUND
ANKENY
GRANGER
JOHNSTON
ALTOONA
208 STUDY AREA BOUNDARY
DALLAS
COUNT
GRIMES
URBANDALE
WAUKEE
WEST DES MOINES
CUMMING
NORWALK
W A R R E
U N T Y
208 STUDY AREA BOUNDARY

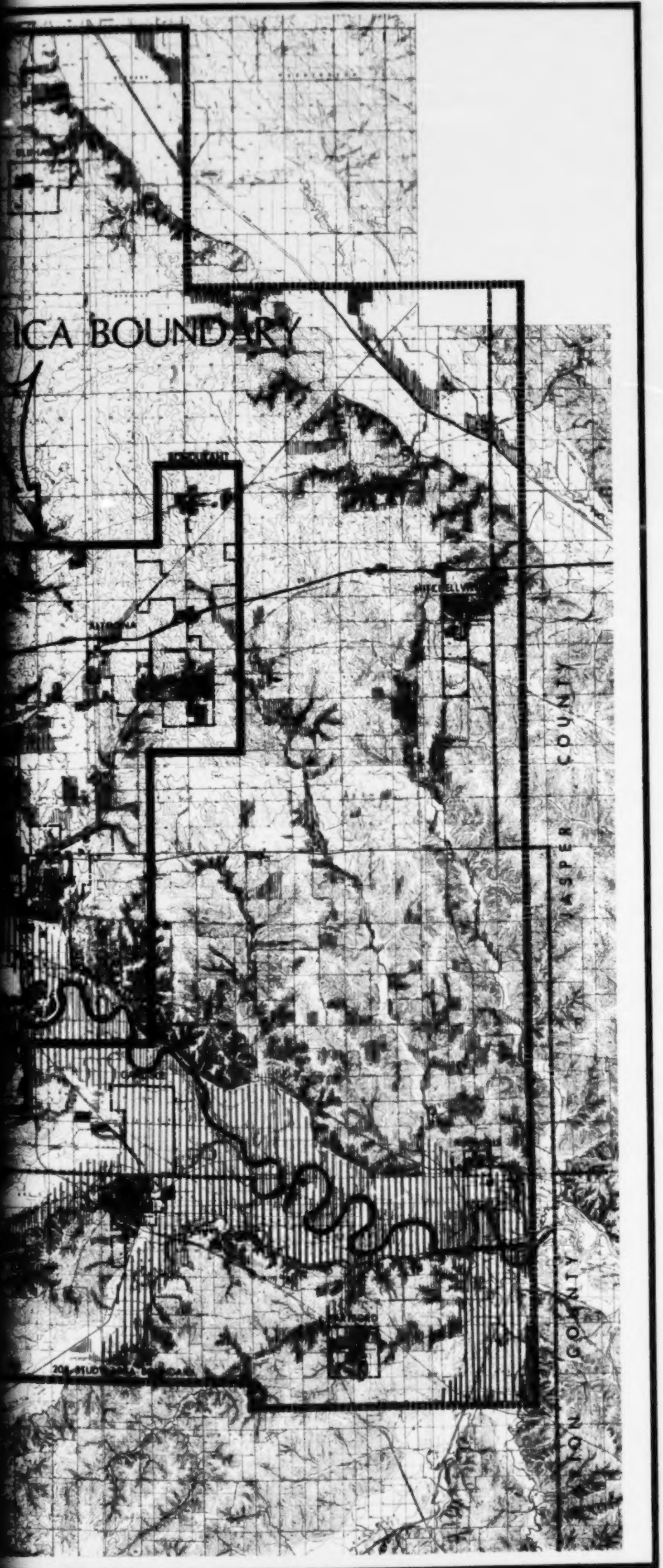


FIGURE 2

EXISTING LAND USE
· YEAR 1975 ·

- ▤ RESIDENTIAL - LOW DENSITY (LESS THAN 1 D.U./ACRE)
- ■ RESIDENTIAL - MEDIUM DENSITY (1 TO 6.9 D.U./ACRE)
- ■ RESIDENTIAL - HIGH DENSITY (7 OR MORE D.U./ACRE)
- ▥ NON-RESIDENTIAL LOW INTENSITY
- ▨ NON-RESIDENTIAL LOW INTENSITY (SPECIAL)
- ▦ NON-RESIDENTIAL MEDIUM INTENSITY
- ■ NON-RESIDENTIAL HIGH INTENSITY
- ☐ CROPLAND
- ☐ PASTURE, FOREST & VACANT
- ■ PERMANENT OPEN SPACE
- ■ WATER
- ▥ FLOOD PLAIN

Source: DES MOINES 208 AREAWIDE WASTE MANAGEMENT PLAN

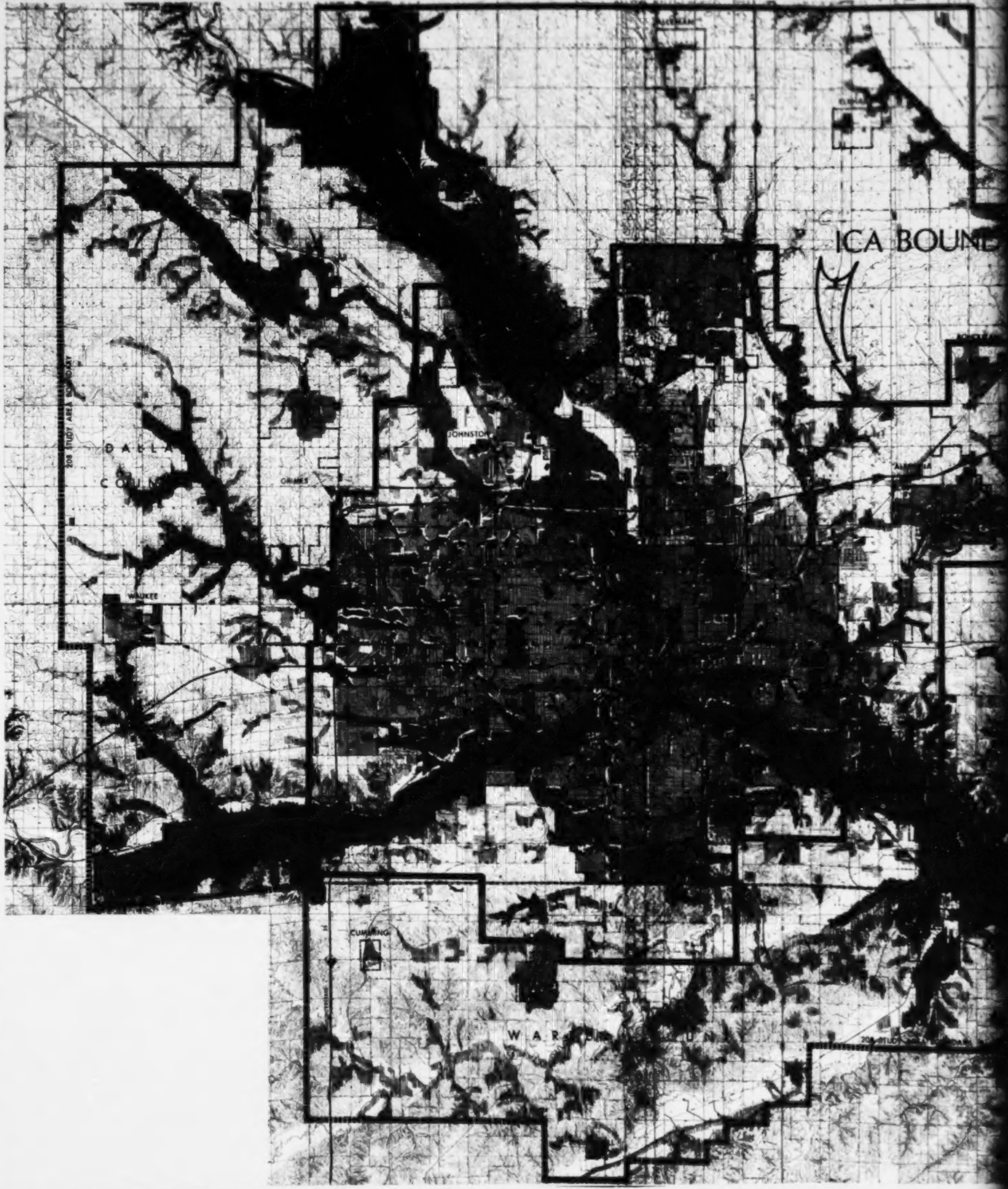
0 1 2 3 4
SCALE - MILES

NORTH

CITY OF DES MOINES

Des Moines ICA Sludge Management
Environmental Impact Statement

Prepared by:
TenEch Environmental Engineers, Inc.
in association with
Engineering-Science, Inc.


ICA BOUND
208 STUDY AREA BOUNDARY
DALLA
COUN
JOHNSTO
GRIMES
WAUKEE
CUMMING
WAR
UN
208 STUDY AREA BOUNDARY

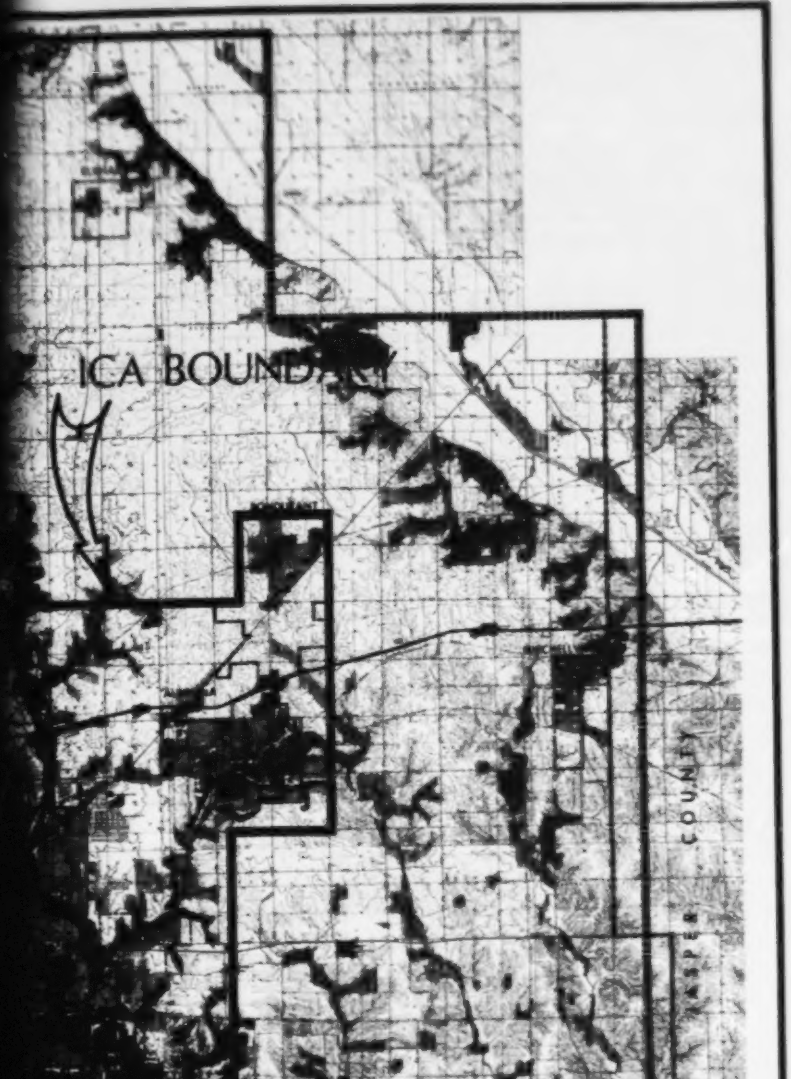


FIGURE 3

FUTURE LAND USE
·YEAR 2000·

- ▤ RESIDENTIAL - LOW DENSITY (LESS THAN 1 D.U./ACRE)
- ▩ RESIDENTIAL - MEDIUM DENSITY (1 TO 6.9 D.U./ACRE)
- ■ RESIDENTIAL - HIGH DENSITY (7 OR MORE D.U./ACRE)
- ▥ NON-RESIDENTIAL LOW INTENSITY
- ▨ NON-RESIDENTIAL LOW INTENSITY (SPECIAL)
- ▦ NON-RESIDENTIAL MEDIUM INTENSITY
- ■ NON-RESIDENTIAL HIGH INTENSITY
- ☐ CROPLAND
- ▥ PASTURE, FOREST & VACANT
- ■ PERMANENT OPEN SPACE
- ■ WATER

Source: DES MOINES 208 AREAWIDE WASTE MANAGEMENT PLAN

0 1 2 3 4
SCALE - MILES

NORTH

CITY OF DES MOINES

Des Moines ICA Sludge Management
Environmental Impact Statement

Prepared by:
TenEch Environmental Engineers, Inc.
in association with
Engineering-Science, Inc.

TABLE 6

POPULATION BY ICA COMMUNITY 1970-1980

ICA Community	1970	1980	% Change
Altoona	2,883	5,764	99.6
Ankeny	9,151	15,429	68.6
Bondurant	462	1,283	177.7
Clive	3,005	5,906	96.5
Des Moines	201,404	191,003	-5.2
Johnston	222	2,617	1,078.8
Pleasant Hill	1,535	3,493	127.6
Urbandale	14,434	17,869	23.8
West Des Moines	16,441	21,894	33.2
Windsor Heights	6,303	5,632	-10.6
Subtotal	255,840	270,890	5.9
Polk County ICA	N/A	15,873	-
Warren County ICA	N/A	4,066	-

N/A - Not Available

SOURCE: Bureau of the Census, 1980

Warren and Polk Counties

The 1980 populations of Warren and Polk counties are 34,878 and 303,170, respectively. During the 1970's, Polk County's population grew by 6.0 percent, while Warren County experienced a 27.1 percent increase.

Population Projections

Projections of population for the ICA communities are provided in Table 7. These may be compared with the Polk and Warren counties population projections which are given in Table 8.

RECREATION

All units of government are participating in the development of recreational lands. The federal government (U.S. Army Corps of Engineers) has developed Lake Red Rock and Saylorville Lake, both of which are impoundments of the Des Moines River. The state operates several parks in the region including Walnut Woods and the recreational resources at Big Creek Reservoir. Many communities are acquiring or reserving land along the major rivers as part of their open space prognosis in addition to developing community parks. Programs to provide publicly owned open spaces along the Des Moines and Raccoon rivers and the establishment of floodplain and conservation districts along the North, Middle, and South rivers are of particular interest.

In the vicinity of the two general sites considered for sludge application are the Southeast Polk County Park and the Thomas Mitchell Park, both of which are located in southeastern Polk County. As presently planned, the proposed project will have little or no involvement with recreational lands.

TRANSPORTATION

Roadway, railroad, and air travel are the primary modes of transportation used in the region of the proposed project. While roadways serve all areas, railroad transportation is concentrated on lines passing through Des Moines. The Des Moines Municipal Airport serves as the primary center for aviation operations in the project area.

Roadways of a variety of types serve the region. Minor streets and arterials are found in urbanized areas along with county, state, interstate, and federal highways. Rural and sparsely populated areas, including those considered for sludge application, are served by county, state, and federal highways, as well as a variety of local roadways which are classified depending on surface composition and design width. In general, the local roads are lightly traveled. Many are adequate in design to carry heavy, agriculturally related trucks and significantly higher traffic volumes.

Railroads in the region are concentrated around Des Moines. These include the Burlington-Northern, the Chicago Rock Island and Pacific, the

TABLE 7

POPULATION PROJECTIONS
DES MOINES ICA

ICA Communities	1980 Census	1990 Projection	2000 Projection	2005 Projection	Percentage Increase 1980-2005
Altoona	5,764	9,000	12,000	13,500	134
Ankeny	15,429	19,500	24,000	26,000	69
Bondurant	1,283	2,000	3,000	3,500	174
Clive	5,906	7,500	9,000	9,500	61
Des Moines	191,003	198,000	205,000	208,500	9
Johnston	2,617	5,000	7,500	8,500	225
Pleasant Hill	3,493	6,000	8,500	9,000	158
Urbandale	17,869	22,500	27,000	29,000	62
West Des Moines	21,894	27,500	33,000	36,000	64
Windsor Heights	5,632	6,000	6,500	7,000	24
Subtotal	270,890	303,000	335,500	350,500	
Polk County ICA	15,873	16,500	17,500	18,800	13
Warren County ICA	4,066	5,000	5,500	6,000	47
Subtotal	19,939	21,500	23,000	24,800	
TOTAL	290,829	324,500	358,500	375,300	29

SOURCES: Bureau of the Census, 1980
CIRALG, 1981

TABLE 8

POLK AND WARREN COUNTIES POPULATION PROJECTIONS

County	1980	1990	2000
Polk	303,170[1]	-	379,250[2]
Warren	30,500[3]	35,000[3]	-
	36,908[4]	45,848[4]	50,873[4]
	33,000[5] (1979 estimate)	-	50,000[5]

[1] SOURCE: Bureau of the Census, 1980

[2] SOURCE: CIRALG, 1981

[3] SOURCE: CIRALG, 1974

[4] SOURCE: Iowa Office of Program Planning, 1977

[5] SOURCE: Veenstra and Kim, 1979

Norfolk and Western, and the Central and Northwestern rail lines. All of these lines pass through Des Moines. The line closest to the Des Moines Main Plant is the Burlington-Northern which passes directly by the treatment plant.

No airports are in close proximity to either the Des Moines Main Plant or those areas under consideration for sludge application.

SOCIOECONOMIC SETTING

Polk and Warren Counties Agricultural Economy

Agriculture represents a significant contribution to the economies of both Polk and Warren counties. Almost 70 percent of Polk County's land area is presently in agricultural use, while 91 percent of Warren County is utilized for agricultural purposes (Bureau of Census, 1978).

Principal crops in both counties are (in descending order) corn, soybeans, and oats. Other crops include wheat, sorghums, barley, hay, and selected fruits, all of which are of relatively minor importance to the overall agricultural economies in the counties.

Livestock, poultry, and their products are also important to the agricultural economies representing nearly 33 percent and 60 percent of the total market value of all agricultural products produced in Polk and Warren counties, respectively. Cattle, hogs, and dairy products represent the principal livestock commodities produced in both counties. Table 9 provides a comparison of selected agricultural product values in Polk and Warren counties with statewide totals.

Commercial Fertilizer Utilization

According to the 1978 Census of Agriculture, a total of 1,747 farms utilized commercially produced fertilizer to enhance the productivity of 205,005 acres of land within the two counties. The total cost to farm operators for fertilizer alone was $6,884,000 (Bureau of Census, 1978). Table 10 shows a breakdown of commercial fertilizer utilization and costs for Polk and Warren counties and the state as a whole. Nitrogen fertilizers are manufactured in several cities in Iowa, including Sioux City, Clinton, Creston, and Fort Madison, utilizing raw materials originating primarily in the gulf states (Snyder, 1981). Apparently, the fertilizer required for the agricultural economy of the state is in adequate supply. The only time at which the state experienced a short supply was 1973 and 1974 which was associated with the oil embargo.

Urban/Rural Characteristics

The socioeconomic characteristics of the Des Moines ICA service area do not differ greatly from the characteristics of the areas under consideration for sludge land application. What differences are apparent reflect the urban/rural contrast: Des Moines Main Plant serves the urbanized Des Moines area, while the potential sludge disposal areas are sit-

TABLE 9

COMPARISON OF CROP AND LIVESTOCK VALUES
POLK AND WARREN COUNTIES

	Polk (value x $1,000)	Warren (value x $1,000)	State (value x $1,000)
Market value of all agricultural products sold	50,597	47,817	8,211,280
Crops	33,973	19,021	3,158,265
Livestock, poultry, and their products	16,624	28,796	5,053,015
Grains	31,914	17,518	3,044,436
Hogs and pigs	7,052	14,509	2,068,623
Cattle and calves	7,190	11,467	2,488,822
Dairy products	1,141	1,699	314,120

*1978

SOURCE: Bureau of the Census, 1978

TABLE 10

COMMERCIAL FERTILIZER UTILIZATION*

	Number of Farms Using Commercial Fertilizer	Number of Acres on Which Used	Value of Commerical Fertilizer (x $1,000)
Polk County	831	114,580	4,181
Warren County	916	90,425	2,703
State of Iowa	100,997	15,285,328	483,429

*1978

SOURCE: Bureau of the Census, 1978

uated in rural portions of Polk and Warren counties. The greatest differences are contrasts between Polk and Warren counties as reflected in Table 11.

Table 11 shows some of the differences among the socioeconomic characteristics of the four areas. In 1970, 92.9 percent of the population was concentrated in the ICA. Only 39.8 percent of Warren County's population was considered urban in 1970, with most being concentrated in Indianola, Norwalk, Carlisle, and suburban areas south of Des Moines. Census Tract 107 consists of Clay, Camp, and Beaver townships in Polk County, one area (of two) in which sludge application is considered. Socioeconomic data specific to the area considered for sludge application in Warren County are not available.

Land Values and Farm Income

Bureau of Census figures (Bureau of Census, 1978) indicate that the average farm in Polk and Warren counties, respectively, contained 228 and 231 acres and was valued at $435,394 and $283,516. These figures represent the value of both land and buildings. Average farmland values (1978) on a per acre basis are $1,905 and $1,265 in Polk and Warren counties, respectively (Bureau of Census, 1978).

Farms and farmland values escalated dramatically from 1974 to 1978. In Polk County, the average per acre value of farmland rose from $882 to $1,905, representing a 116 percent increase in just four years. Warren County farmland values rose from $585 per acre to $1,265 per acre during the same period, also for an increase of 116 percent.

Gross farm income (value of agricultural products before taxes and farm expenses) in 1978 averaged $44,737 per Polk County farm and $34,009 per farm in Warren County (Bureau of Census, 1978).

Employment

The employment-generating facilities associated with the proposed project will be located in Polk County, The major employment classifications in Polk County are provided in Table 12.

Currently (September, 1981), the unemployment rate in Polk County is 4.9 percent (Culp, 1981). The national rate at this time is 7.1 percent. Caution should be utilized in comparing these unemployment rates since the national figure is adjusted for seasonal employment; over the short term, unemployment is expected to climb due to announced manufacturing plant closures and layoffs.

VISUAL AESTHETICS

The rural regions of the study area are characterized by rolling and hilly topography. While there are no particularly striking features in the agricultural areas, an expansive and restful atmosphere provides a

TABLE 11

CONTRASTING SOCIOECONOMIC CHARACTERISTICS

Characteristic	Criterion	Polk County	Des Moines	Warren County	Census Tract 107[1]
Total population	Number of people (1970)	286,101	200,587	27,432	6,639
Mobility/stability	Live in same house 1965-1970	51.80%	53.73%	52.50%	47.50%
Commuting patterns	Work in county of residence	97.08%	97.3%	48.92%	95.65%
Education	High school graduates 25+ years old	41.45%	40.72%	42.46%	48.81%
	College graduates 25+ years old	12.77%	11.65%	8.03%	7.37%
Family size	Persons per household	2.98	2.83	3.26	3.36
Income	Median family income	10,682	10,239	9,958	10,152
Age	Median age	27.7	-	25.6	-
Farm population	Number of farm-related jobs - farmers, managers, foremen, workers	1,170	251	995	159
	Farm and related jobs per 100,000 population	409	125	3,627	2,395

[1] Includes Clay Camp and Beaver townships in Polk County; approximates the general area under consideration for land application of sewage sludge in Polk County.

SOURCE: Bureau of the Census, 1970

TABLE 12

POLK COUNTY EMPLOYMENT PATTERNS, 1979

Category	Number Employed
Agricultural services	759
Mining	147
Contract construction	9,172
Manufacturing	28,716
Transportation and other public utilities	12,550
Wholesale trade	14,001
Retail trade	31,854
Finance, insurance, real estate	21,052
Services	37,997
Other nonclassified	910
TOTAL	157,158

SOURCE: County Business Patterns - Iowa, 1979 pleasant contrast to the urbanized portions of the ICA. Polk County farms tend to be more heavily committed to crop production, while those in Warren County are used more for pasturing purposes.

The city of Des Moines, with its urban redevelopment program, provides an array of cultural attractions including the gold-domed State Capitol building. City parks and the riverfront afford settings for many cultural and recreational activities.

PUBLIC HEALTH

The agencies charged with maintenance of the public health, particularly with regard to drinking water and public water supplies, in Polk and Warren counties are the respective county health departments. These agencies, however, are not responsible for monitoring public wastewater treatment facilities or sludge disposal operations. The Iowa Department of Environmental Quality (IDEQ) is charged with this task. IDEQ is also responsible for permitting wastewater dischargers and sludge disposal operations. IDEQ has also established criteria to ensure that heavy metals in sludge (zinc, copper, cadmium, etc.) will not harm plants or the soil. Further, IDEQ has established regulations to protect public health by restricting sludge application on certain crops that may be consumed by humans (IDEQ, 1979).

ARCHAEOLOGICAL AND HISTORICAL SITES

Archaeological Sites

Coordination with the State Historic Preservation Officer (SHPO) (Iowa State Historical Department, 1981) revealed the presence of one known archaeological site, 13PK12, within the potential area considered for sludge application in Polk County. The SHPO also identified six archaeological sites within the potential area of Warren County considered for sludge application. These include sites 13WA4, 13WA5, 13WA6, 13WA7, 13WA103, and 13WA106. The following discusses the various cultures from which these cultural remnants may stem.

About 10,000 B.C., small groups of Stone Age hunters called Paleo-Indians lived within the borders of Iowa. Their ancestors had migrated from northeastern Siberia and gradually spread across the North and South American continents. The earliest known evidence indicates that these hunters flourished from about 10,000 B.C. to 7000 B.C. (Iowa Conservation Commission, 1972). Scattered surface finds from this period have been found since 1962 (U.S. Army Corps of Engineers, 1975).

During the Archaic Indian Tradition, 7000 B.C. to 500 B.C., a culture known as the Keg Creek Complex developed around 3500 B.C. Discoveries attributable to this tradition in the Red Rock Region are reported by McKusick, et al, 1962, and Gradwohl, 1973.

The Archaic Tradition was succeeded about 500 B.C. in the region by the Woodland Tradition. The Indians of this period are noted for mound building and burial cults (Iowa Conservation Commission, 1972).

The Woodland Tradition in the study area was succeeded by the Mississippian Tradition, represented primarily by the Oneota Manifestation which first appeared in the area about 950 A.D. The Oneota Manifestation is thought to be a precursor of the Ioway Indians.

By 1200 A.D., the Oneota Tradition dominated the area; and inhabitants of the region began to practice extensive buffalo hunting along with systematic agricultural endeavors. The Oneota culture spread from east to west; and, in historic times, became known as the Ioway, hence the name of the state (Iowa Conservation Commission, 1972).

No detailed archaeological surveys of the considered sludge application sites have been conducted to date. Once specific sites for sludge disposal are selected, an archaeological reconnaissance should be conducted to determine the presence of cultural artifacts. Sludge application activities will be conducted on existing cropland, disturbing only the plow layer; therefore, no significant adverse impacts to archaeological sites are anticipated since previous cultivation would have already disturbed any such sites.

Historical Sites

Although the Des Moines River Basin has a rich history of early settlement, only one site within the potentially affected disposal area is on the National Register of Historical Sites (Iowa State Historical Department, 1981). That site, the Palmyra Methodist Episcopal Church, is located in Palmyra, Warren County. The Palmyra Methodist Episcopal Church remains the focus of community identity in this small agricultural center. Organized as the first Methodist congregation in 1853, the church members erected a larger structure between 1867-70. This current building served, not only the religious needs of the church, but became the county gathering place for social and cultural activities. The frame rectangular building with round arched windows and bell tower entrance is a typical example of rural Iowa church architecture.

A survey of central Iowa architecture conducted by CIRALG also identifies two structures in the area of concern which appear to be eligible for nomination to the National Register. They are: the Carlisle Railroad Depot and the Dr. Franklin C. Hull Residence, both of which are located in Carlisle. Since the proposed project operation will not disturb any existing historical sites, no historic survey was conducted for this project.

FRAGILE ENVIRONMENTAL RESOURCES

Sources of Potable Water

The potable water source supplying the greatest number of people in the ICA is the Lower Raccoon River and the alluvial aquifer system associated with it. At present, approximately one half of the water is taken from the river directly; and one half is taken from infiltration galleries buried in the aquifer (EPA, et al, 1977). Back-up facilities include the

Dale Moffitt Reservoir, at the Polk, Warren, Dallas, and Madison county intersection, which is charged by pumpage from the Raccoon River during favorable flow conditions and discharged to the river under low flow conditions. The other back-up system is a set of infiltration galleries emplaced along the Des Moines River near the Raccoon confluence.

According to well logs filed by the Iowa Geological Survey, there are over 100 wells in use throughout the Des Moines 208 area, one half of which penetrate to maximum depths of 400 feet below the surface. Approximately one third have depths of 400 to 500 feet, with the remaining wells deeper than 500 feet.

An inspection of Polk County Health Department well logs revealed that there are over 25 wells within the Polk County area considered for sludge application; nearly one half of these wells are at depths of 30 feet or less. Of the remaining wells, the deepest is 145 feet. Elevated nitrogen and fecal coliform levels have been noted in many of the wells in this area. Contamination by surface pollutants (such as nitrates, for example) is a constant threat to shallow wells in agricultural areas. Because of this, Polk County plans to extend municipal water lines to the area considered for sludge application in the near future. No well log data for Warren County are available.

The most recent municipal well data for the areas considered for sludge application were obtained from the University Hygienic Laboratory. These data include the communities of Carlisle, Bondurant, and Mitchellville. All of these community wells are at depths between 50 and 70 feet. Nitrate concentrations range from 2.2 to 28 mg/l. All wells exhibit very low concentrations of heavy metals, although the Mitchellville wells do yield water with lead concentrations ranging from 0.05 to 0.82 mg/l. Concentrations of copper are also higher in the Mitchellville samples than the others, ranging from 0.04 to 0.23 mg/l. Land application of sludge could affect both nitrate and heavy metals concentrations in shallow wells.

Wetlands

Wetlands in close proximity to the potential land application areas are largely ephemeral, occurring on a seasonal basis in the floodplain of the Des Moines River. The potential Polk County disposal area includes a 350-acre, state managed, freshwater wetland system comprised of Type 3 (inland open freshwater) and Type 5 (inland shallow fresh marshes) wetlands (U.S. Department of the Interior, 1981). Wetlands should be avoided as sludge disposal sites.

Floodplains and Flood Retention Areas

The floodplain of the Lower Des Moines River is included in the 100-year flood retention basin for Lake Red Rock. Floodplains for the Middle and South rivers, as well as Butcher, Spring, Mud, and Camp creeks, are located in the potential sludge disposal areas (see Figure 4). Sludge dis-disposal within these floodways should be avoided so as not to adversely affect surface water quality of groundwater recharge zones.

Steeply Sloping Lands

Steeply sloping areas (slopes of 14 percent and over) are generally limited to side slopes of the major river valleys. Sludge application on steep slopes poses a threat to surface water quality associated with runoff from these areas. Figure 4 delineates areas of steep slopes. It should be noted that, if sludge is applied to land on which the soil loss exceeds limits established by the county soil conservation district, IDEQ rules require that the sludge be incorporated with the soil to mitigate possible adverse water quality impacts.

Groundwater Recharge Areas

The most significant groundwater recharge areas overlie the alluvial aquifers along major rivers and streams. To lessen the potential for groundwater contamination, sludge application should not occur in these areas (see Figure 4).

EXISTING SOLIDS MANAGEMENT

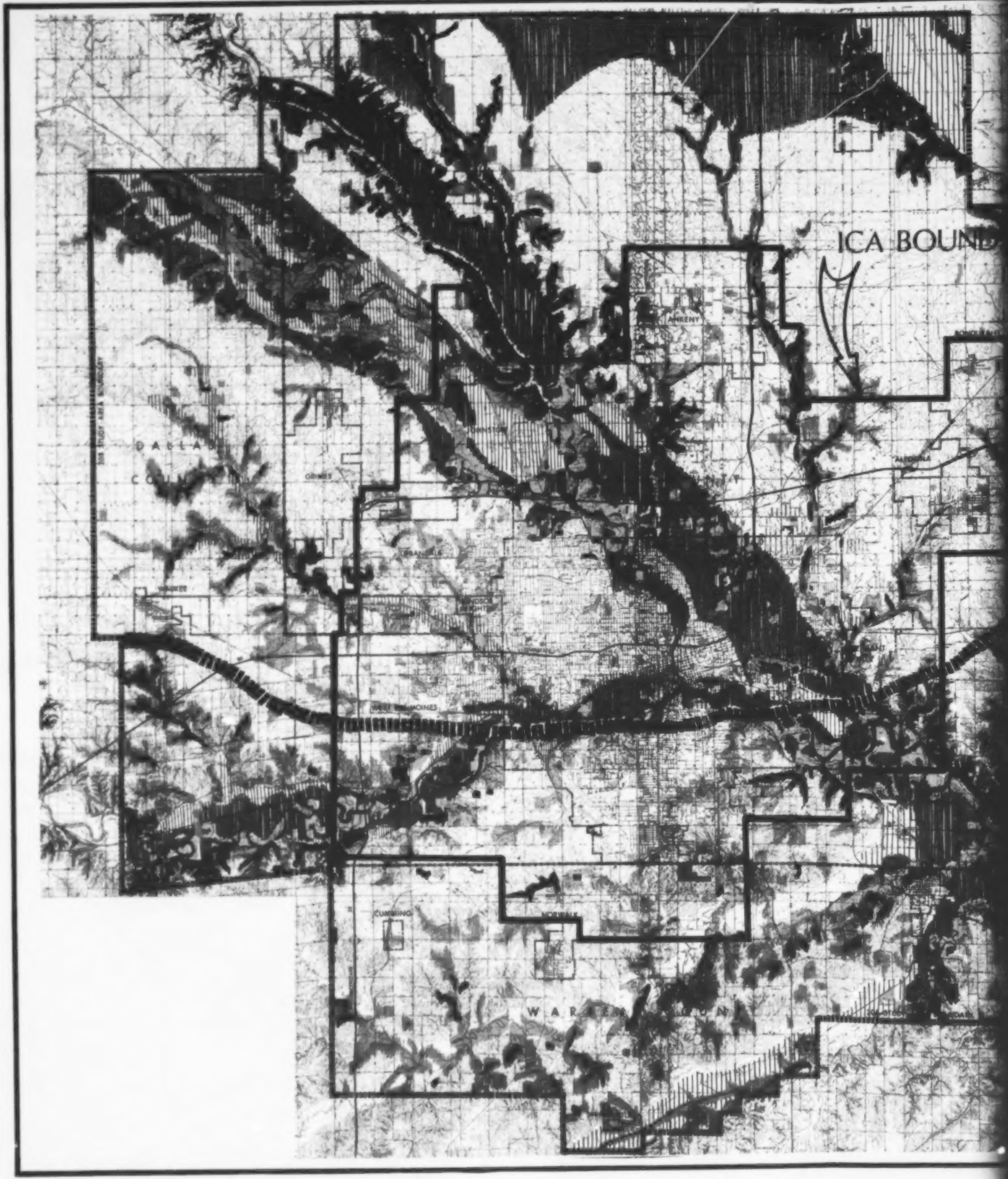
Solids Generation and Disposal

Presently, some 15,150 tons per year of sludge (dry weight) are handled by municipal wastewater treatment facilities in the ICA. Of this total, nearly 17 percent is land applied, with the remaining tonnage being disposed in the Metro Landfill. While no problems have been noted with these practices, the disposal of approximately 12,600 tons of sludge in the Metro Landfill does consume valuable landfill capacity and could threaten groundwater resources in the area. That portion of sludge which is land applied is done so at low rates (less than two tons per acre per year) on various sites in Polk County. Figure 5 indicates current sludge disposal sites, while Table 13 summarizes existing solids handling systems. Locations of existing municipal wastewater treatment facilities are shown in Figure 6.

Energy Requirements

A primary energy analysis for the eleven major wastewater treatment facilities within the Des Moines ICA has been prepared in order to provide a basis for evaluating the energy impact of the alternative solids handling process and is presented in Table 14. The primary energy uses include the electrical power requirements of the sludge processing equipment at each of the facilities and the fuel requirements for transport and disposal of the sludge generated at each of the facilities. For the six wastewater treatment facilities that use anaerobic digestion to stabilize the sludge, primary energy production was estimated based on the gas generated by the digesters.

Based on the analysis, the estimated annual energy use for sludge management within the ICA is 62,640 MBtu, of which 52,700 MBtu or 85 percent are used at the Des Moines Main Plant; and the estimated annual energy production is 47,150 MBtu, of which 43,800 MBtu are produced by the Des Moines Main Plant. Thus, net energy use for sludge management within the ICA is 15,490 MBtu.

ICA BOUND
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208 STUDY AREA BOUNDARY
DALLA
CO
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JOHNSTON
URBANDALE
WAUKEE
WINDSOR HEIGHTS
MOINES
ALTOONA
CUMMING
NORWALK
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COUN

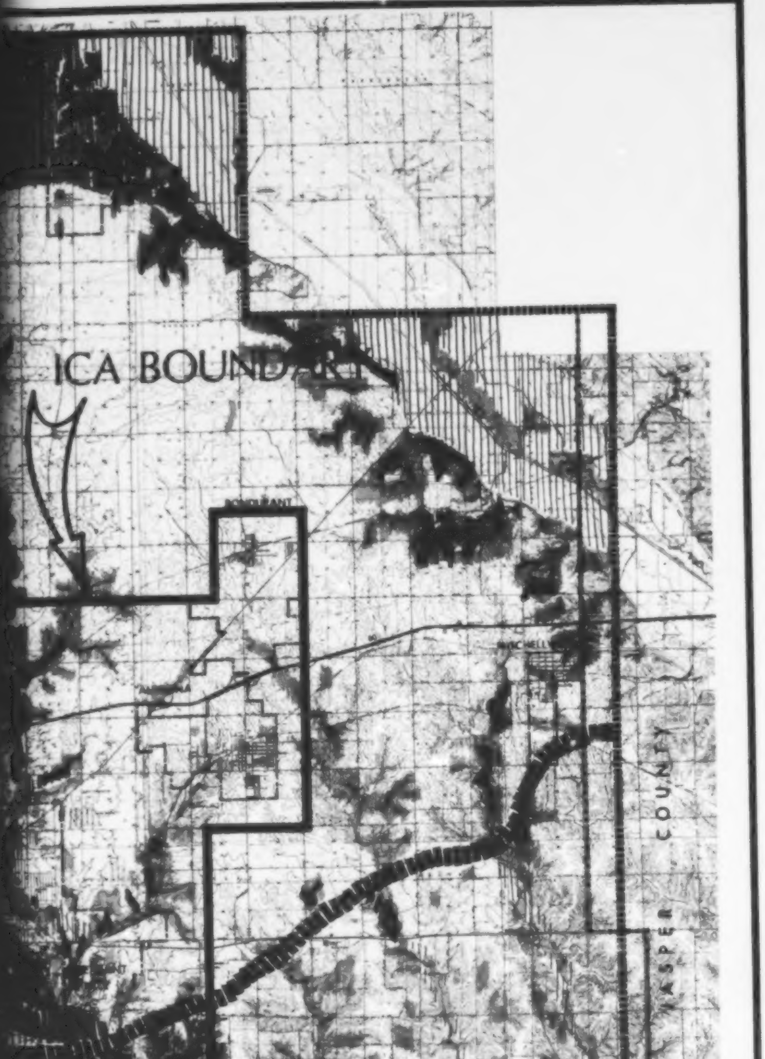

FIGURE 4

ENVIRONMENTALLY SENSITIVE AREAS

- ■ FLOOD-PRONE AREAS
- ▥ SURFICIAL AQUIFERS
- ▨ BURIED CHANNEL AQUIFERS
- ■ STEEP SLOPES (14% AND OVER)
- ▤ PASTURE, FOREST & VACANT LAND
- ▬ GENERAL LOCATION OF SOUTHERN LIMITS OF WISCONSIN GLACIER

Source: DES MOINES 208 AREAWIDE WASTE MANAGEMENT PLAN

0 1 2 3 4

SCALE - MILES

NORTH

CITY OF DES MOINES

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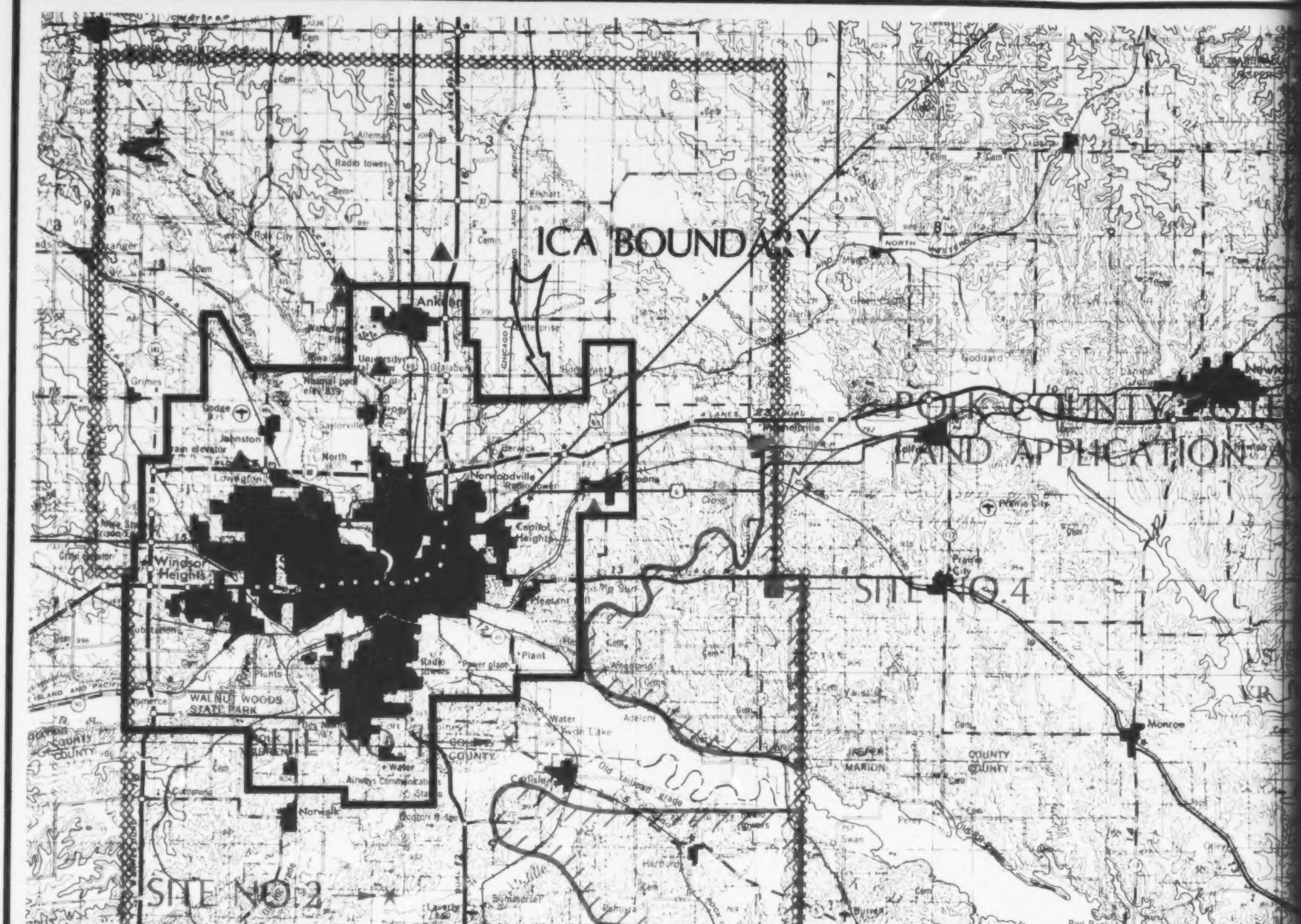
ICA BOUNDARY
POLK COUNTY POTE
LAND APPLICATION A
SITE NO.1
SITE NO.2
SITE NO.3
SITE NO.4
SITE NO.5
WARREN COUNTY POTENTIAL
LAND APPLICATION AREA
Ankeny
Windsor Heights
Johnston
Saylorville
Norwoodville
Capitol Heights
Pleasant Hill
WALNUT WOODS STATE PARK
Avon Lake
Carlisle
Norwalk
Indianola
Pleasantville
Knoxville
Prairie City
Monroe
Red Rock
Swan
Hartford
Palmyra
Ackworth
LAKE AHQUABI STATE PARK
Greenwood Raceway
Lacona
Dallas
Melcher
Polk City
Granger
Grimes
Elkhart
Alleman
Mitchellville
Colfax
Goddard
Old railroad grade
MARION COUNTY
JASPER COUNTY
WARREN COUNTY
MARION LUCAS
MARION MONROE

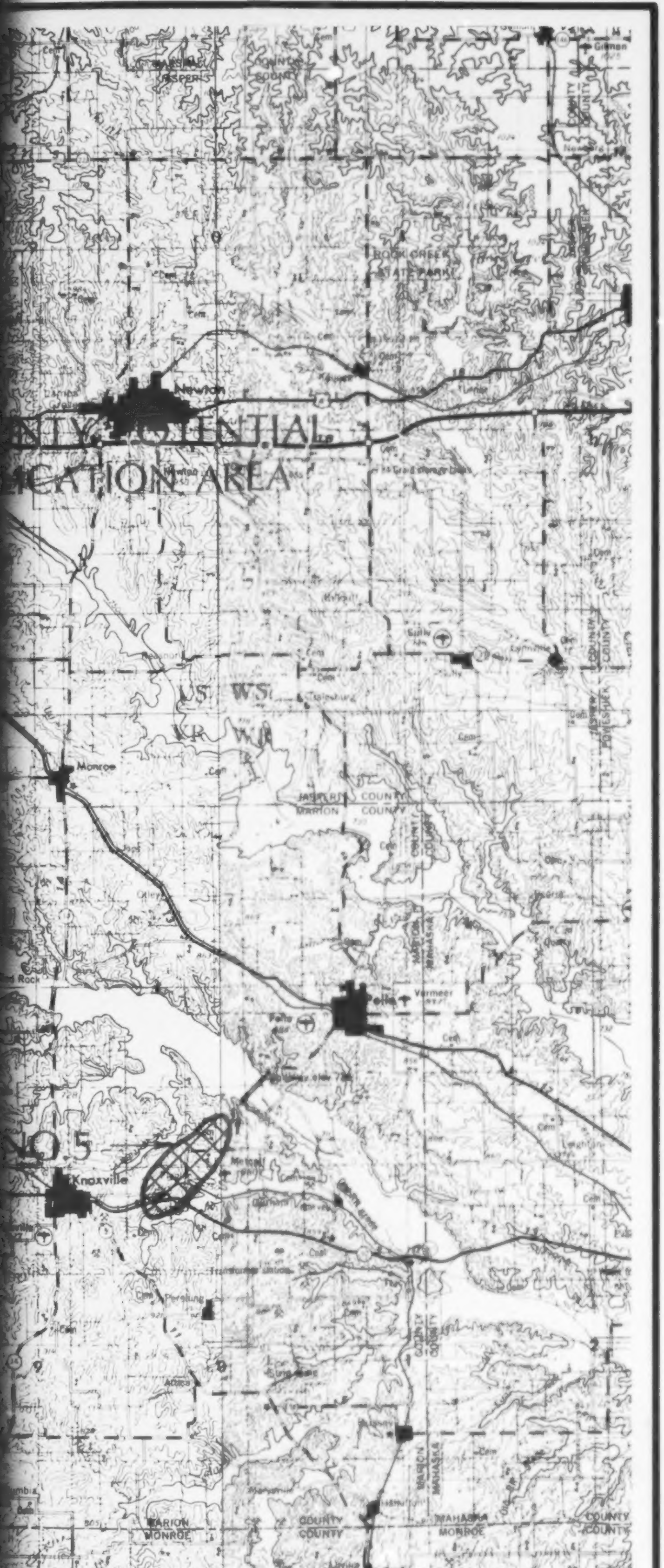
Newton
POTENTIAL
LICATION AREA
ROCK CREEK STATE PARK
Monroe
JASPER COUNTY
MARION COUNTY
Pella
Knoxville
NO.5
MARION COUNTY
MONROE COUNTY
MAHASKA COUNTY
MONROE COUNTY

FIGURE 5

LOCATION OF EXISTING AND POTENTIAL SEWAGE SOLIDS DISPOSAL AREAS

≈≈≈	PREFERRED LAND APPLICATION AREA BOUNDARY
◯	POTENTIAL LAND APPLICATION AREA
⊗	POTENTIAL LAND RECLAMATION AREA
*	REPRESENTATIVE LAND APPLICATION SITE
■	METRO EAST LANDFILL
▲	EXISTING LAND APPLICATION SITE

NOTE: The potential land application areas are those generalized areas with the highest potential for locating suitable land application sites within Polk and Warren Counties. Suitable sites for land application, however, may be found throughout Polk, Warren and surrounding counties.

0 1 2 3 4
SCALE - MILES

NORTH

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TABLE 13

EXISTING SOLIDS HANDLING DATA
DES MOINES ICA

	WWTP Name	Design Flow (MGD)	Quantity of Sludge Generated	Disposal Method	Transport Mode	Disposal Location	Comments
1.	Altoona	0.6	3,000 gal/day @ 4% solids (190 dry ton/year)	Low rate land application	Truck	Clay Township	Altoona applies sludge to several private sites within one mile of the treatment plant. No formal agreements with landowners.
2.	Ankeny-Southeast	1.2	3 million gal/year @ 5% solids (650 dry ton/year - includes West and Westwood treatment plants)	Low rate land application	Truck	Crocker Township	Ankeny applies sludge to several public and private sites including a 13-acre tract in the city, Ankeny Golf Course (under construction), and private land adjacent to the Westwood plant. City has executed formal agreements with landowners.
3.	Ankeny-West	0.25		Low rate land application	Truck	Crocker Township	
4.	Ankeny-Westwood	Unknown		Low rate land application	Truck	Crocker Township	
5.	Bondurant	0.4	Unknown - lagoon has never been emptied	--	--	--	City has considered land application as a sludge disposal method.
6.	Pleasant Hill	0.4	11-12 ton/week @ 20% solids (120 dry ton/year)	Landfill	Truck	Metro Landfill	
7.	Urbandale	0.4	15,000 gal/week @ 7.5% solids (1,712.3 dry ton/year)	Low rate land application	Truck	Section B Webster Township	Urbandale applies sludge to 20 acres owned by sanitary district and private individuals. No formal agreements exist for sludge application on private property.
8.	Des Moines - Main Plant	35.0	30-35 ton/day dry weight (12,000 dry ton/year)	Landfill	Truck	Metro Landfill	
9.	Des Moines - Highland Hills	0.5	2,000 gal/day @ 5-6% solids (167.4 dry ton/year)	Landfill	Truck	Metro Landfill	In addition to utilizing the Metro Landfill, sludges are occasionally disposed on site.
10.	Des Moines - Area B	0.3	Unknown - lagoon has never been emptied	--	--	--	--
11.	Des Moines - Area C	0.3	Unknown - lagoon has never been emptied	--	--	--	--

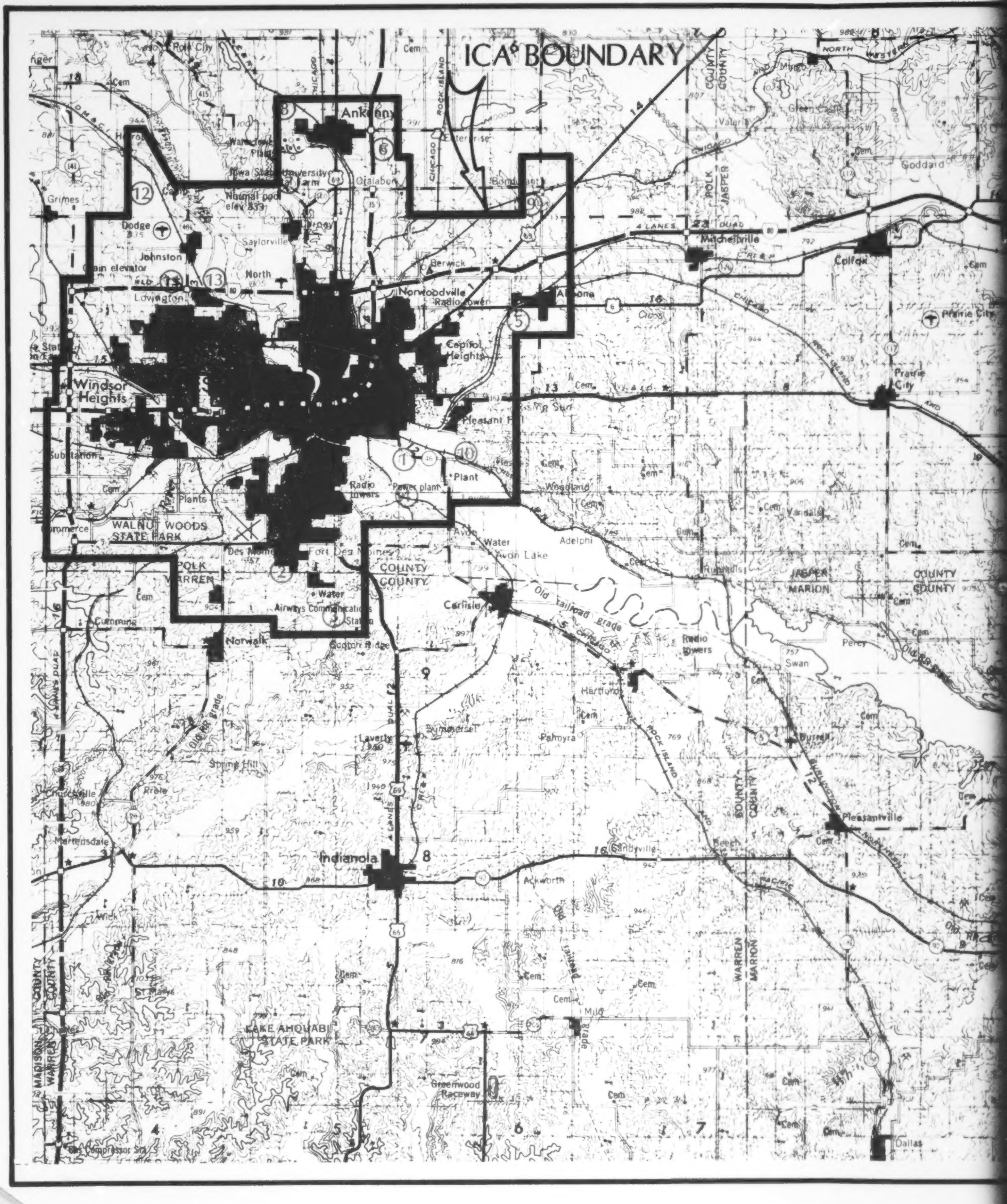
TABLE 13 (continued)

EXISTING SOLIDS HANDLING DATA
DES MOINES ICA

	WWTP Name	Design Flow (MGD)	Quantity of Sludge Generated	Disposal Method	Transport Mode	Disposal Location	Comments
12.	Camp Dodge	0.4	70,000 gal/year @ 10% solids (30 dry ton/year)	Landfill	Truck	Metro Landfill	
13.	Green Meadows	0.32	110,000 gal/year @ 2% solids (9 dry ton/year)	Low rate land application	Truck	Unknown	

NOTE: All septic tank pumpings are disposed at the Des Moines Main Plant. Quantity of septic tank pumpings disposed daily is estimated at 22,500 to 30,000 gallons per day.

SOURCE: Personal communication with city officials and/or WWTP operators


ICA BOUNDARY
Polk City
Ankeny
Iowa State University
Oralabor
Enterprise
Bondurant
Mingo
Valeria
Green Castle
Goddard
Grimes
Dodge
Johnston
Saylorville
Berwick
Norwoodville
Altoona
Mitchellville
Colfax
Prairie City
Lovington
Capitol Heights
Windsor Heights
Pleasant Hill
Substation
Plant
Power plant
Radio towers
Woodland
Vandalia
Commerce
WALNUT WOODS STATE PARK
Fort Des Moines
Avon
Avon Lake
Adelphi
Runnells
POLK
WARREN
COUNTY
COUNTY
JASPER
MARION
Carlisle
Airways Communications Station
Cumming
Norwalk
Scotch Ridge
Old railroad grade
Radio towers
Percy
Swan
Hartford
Summerset
Palmyra
Laverty
Spring Hill
Burrell
Churchville
Prole
Martensdale
Pleasantville
Indianola
Sandyville
Ackworth
Wick
St. Marys
LAKE AHQUABI STATE PARK
Greenwood Raceway
Mild
Dallas
Gas Compressor Sta.
MADISON
WARREN
COUNTY
COUNTY
WARREN
MARION
COUNTY
COUNTY
1
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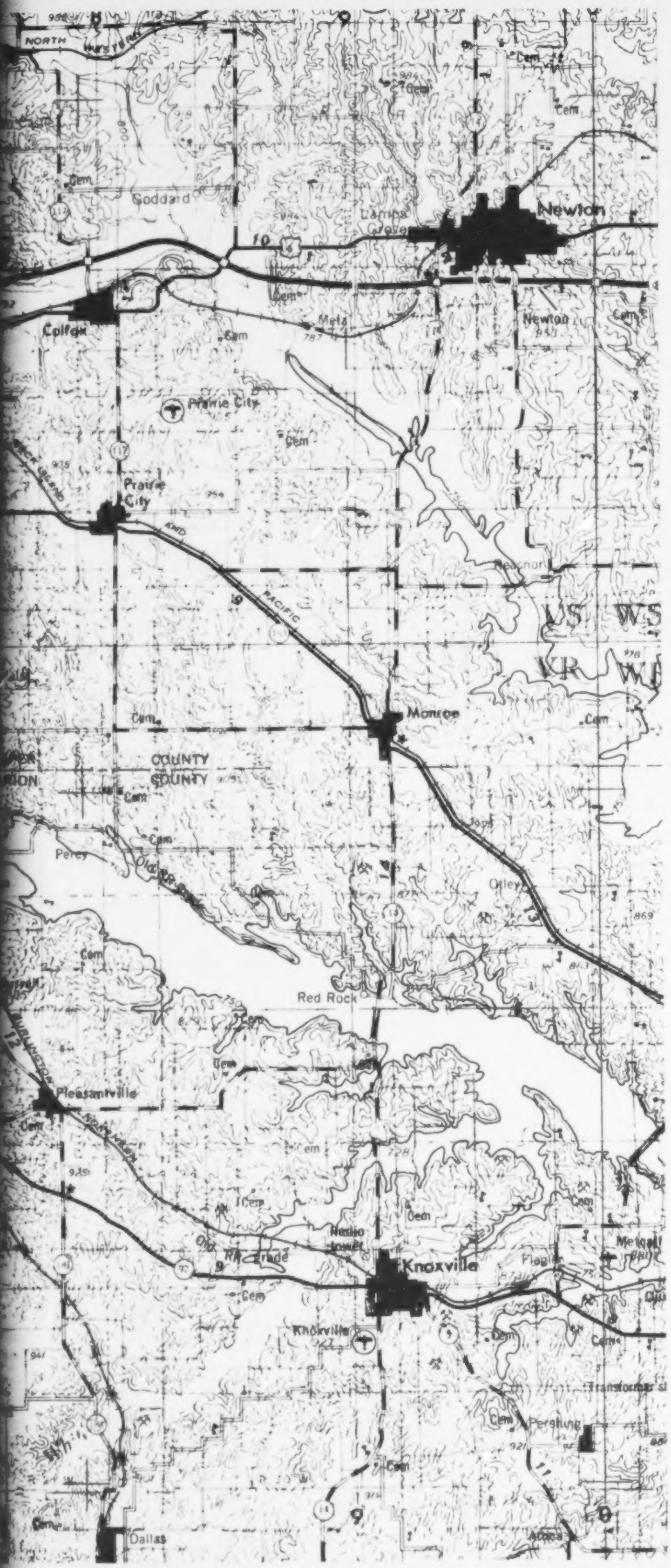


Newton
Colfax
Goddard
Lambs Grove
Metz
Prairie City
Monroe
Otley
Percy
Red Rock
Pleasantville
Knoxville
Pershing
Dallas
NORTH WESTERN
PACIFIC
COUNTY
COUNTY
Cem

FIGURE 6

LOCATION OF DOMESTIC WASTEWATER TREATMENT FACILITIES

MUNICIPAL PLANTS

① DES MOINES - MAIN PLANT
② DES MOINES - HIGHLAND HILLS
③ DES MOINES - AREA B
④ DES MOINES - AREA C
⑤ ALTOONA
⑥ ANKENY - SOUTHEAST
⑦ ANKENY - WEST
⑧ ANKENY - WESTWOOD
⑨ BONDURANT
⑩ PLEASANT HILLS
⑪ URBANDALE

SEMIPRIVATE PLANTS

⑫ CAMP DODGE
⑬ GREEN MEADOWS

0 1 2 3 4
SCALE - MILES
NORTH

CITY OF DES MOINES Des Moines ICA Sludge Management Environmental Impact Statement

Prepared by:
TenEch Environmental Engineers, Inc.
in association with
Engineering-Science, Inc.

TABLE 14

PRIMARY ENERGY SUMMARY

		Estimated Annual Energy Use			
Wastewater Treatment Facility	Annual Sludge Production (gallons)	On-site Sludge Processing (MBtu)	Transport and Disposal (MBtu)	Total (MBtu)	Estimated Energy Production (MBtu)
Altoona	1,100,000	840	430	1,270	690
Ankeny (combined)	3,000,000	600	950	1,550	950
Bondurant	0	0	0	0	0
Pleasant Hill	160,000	1,680	110	1,790	0
Urbandale	780,000	1,050	400	1,450	910
Des Moines - Main	46,000,000	37,800	15,000	52,800	43,800
Des Moines - Area B	0	0	0	0	0
Des Moines - Area C	0	0	0	0	0
Des Moines - Highland Hills	730,000	740	1,600	2,340	690
Camp Dodge	140,000	840	380	1,220	110
Green Meadows	110,000	160	60	220	0
TOTAL	52,020,000	43,710	18,930	62,640	47,150

NOTES: Energy Equivalents:
Electricity - 10,500 Btu/kwh
Diesel Fuel - 14,000 Btu/kwh
Digester Gas - 600 Btu/kwh

SOURCES: U.S. EPA
U.S. Department of Energy

CHAPTER III

DESCRIPTION OF SLUDGE MANAGEMENT ALTERNATIVES

INTRODUCTION

The National Environmental Policy Act required federal agencies to consider "alternatives to the proposed action" in every environmental impact statement. The law does not specify how thorough the alternatives must be; but courts have interpreted it to mean that a "reasonable" number of alternatives must be considered, especially any which may have merit in reducing the negative environmental impacts of the project as originally proposed.

This very broad definition of alternatives suggests that not only are very broad "total system" alternatives to be considered but, where particular features of a given proposal may have unusually severe impact, subalternatives within a system should also be evaluated.

A second factor must be borne in mind in the review of alternatives for a construction grants program project. EPA does not initiate a proposal for construction grant funding; that is the prerogative of any legal wastewater management district. Upon certification by the state, a district evaluates alternatives and develops a plan. The plan is then sent to EPA for final review. Although EPA has developed guidelines to assist grant applicants in order to make them aware of EPA's responsibilities in considering project alternatives, it is inevitable that the applicant will view the alternatives from a somewhat different perspective than will EPA.

To overcome this difficulty, EPA will give equal consideration to all alternatives but will recognize the effort that has been invested in the development of the proposed project. Only if there are significant environmental or other objections to the proposed overall system will a wholly different system be advanced. Even within a given proposal, however, major changes could be required if the situation so warranted.

This chapter describes existing sludge management within the Des Moines ICA, the development of the alternatives presented in the 201 Facilities Plan, and additional alternatives deemed feasible within the Des Moines ICA. Within this description, both the in-plant processing of the sludge and the final disposal of the stabilized sludge solids are addressed.

EXISTING CONDITIONS

Based on the 201 Facilities Plan that has been prepared for the Des Moines ICA, there are presently eleven municipal wastewater treatment facilities within the ICA planning area. Eight of these treatment facilities are mechanical treatment plants which generate sludge on a regular basis, and three of these treatment facilities are lagoons which have not to date generated any sludge for disposal. In addition to these eleven municipal wastewater treatment facilities, eighteen commercial/semiprivate wastewater treatment facilities have also been identified; however, all but two of these facilities either produce no sludge or dispose of their sludge at the Des Moines Main Plant.

A summary of the existing sludge generation and disposal practices for all eleven of the municipal treatment facilities and the two commercial/semiprivate facilities which dispose of their own sludge is provided in Table 15. As indicated, sludge from six of the smaller facilities with a combined annual sludge generation of 1,100 dry tons is now being disposed of by low-rate land application. The remainder of the facilities, including the Des Moines Main Plant, dispose of their sludge at the Des Moines Metro East Landfill. Thus, 12,340 of the 13,440 dry tons of sludge now generated within the ICA planning area are landfilled.

HISTORICAL DEVELOPMENT OF ALTERNATIVES

Since the mid-1970's, the communities within the ICA planning area have been planning for expanding and upgrading existing wastewater treatment facilities; and, in 1977, the Des Moines 208 Areawide Waste Treatment Management Plan was completed. In this study, it was recommended that the wastewater from all the treatment facilities listed in Table 15 be connected to the Des Moines Main Plant and that new facilities be constructed to handle and properly treat this combined wastewater flow.

As part of the 201 Facilities Plan which is now being completed, the wastewater treatment system recommended in the 208 Study was evaluated. Based on a cost analysis of the required conveyance systems and necessary facility upgrading, a modified ICA system was recommended in which only the Urbandale and Pleasant Hill wastewater treatment facilities would be connected to the Des Moines Main Plant. As a result, six wastewater treatment plants within the Des Moines ICA would continue to treat and dispose of sludge.

While it was assumed that, in the future, disposal of all sludge would be coordinated by the ICA, the 201 Facilities Plan only focuses on sludge generated by the Des Moines Main Plant and does not address facility modifications and disposal at the five outlying facilities.

SELECTED ALTERNATIVES

Four alternatives were identified for further evaluation in the Des Moines ICA 201 Study. These were selected by a preliminary and detailed evaluation of many potential processes and systems. The preliminary evaluation eliminated options on environmental impacts, nonmonetary technical factors, and rough capital O&M cost. The detailed evaluation included preparation of a system schematic, development of a site, detailed analysis and comparison of capital cost and O&M cost, along with nonmonetary technical and environmental impacts. The 201 Study then identified the optimum alternative of these four.

TABLE 15

MUNICIPAL TREATMENT FACILITIES WITHIN DES MOINES ICA

Wastewater Treatment Facility	Annual Sludge Production		Stabilization Prior to Disposal	On-site Storage	Ultimate Disposal
	Million Gallons	Dry Tons			
Altoona	1.1	190	Anaerobic Digestion	Tank	Low rate land application
Ankeny	3.0	650			Low rate land application
Southeast			Lime Stabilization	Lagoon	
West			Anaerobic Digestion	Lagoon	
Westwood			Aerobic Digestion	Lagoon	
Bondurant	0	0	Lagoon System	N/A	N/A
Pleasant Hill	0.16	120	—	Tank	Metro Landfill
Urbandale	0.78	250	Anaerobic Digestion	Tank	Low rate land application
Des Moines Main	46	12,000	Anaerobic Digestion	Gravel Bed	Metro Landfill
Des Moines - Area C	0	0	Lagoon System	N/A	N/A
Des Moines - Area B	0	0	Lagoon System	N/A	N/A
Des Moines - Highland Hills	0.73	190	Anaerobic Digestion	Drying Beds	Metro Landfill/on-site
Camp Dodge[1]	0.07	30	Anaerobic Digestion	Tank	Landfill
Green Meadows[1]	0.11	9	Aerobic Digestion		Land application

[1] Commercial/semiprivate facility

The four alternatives and variations identified in the 201 Study are detailed and discussed on the following pages. The final section explains the selection of Alternative 1a as the optimum by the 201 Study.

Alternatives 1a and 1b

Alternatives 1a and 1b are identical except for stabilized sludge dewatering. Both alternatives use dissolved air flotation thickening; anaerobic digestion for stabilization; and, following dewatering, truck transportation and ultimate disposal by land application. Under Alternative 1a, a belt filter press is used for dewatering; while, under Alternative 1b, dewatering is by centrifuge. Flow charts for Alternatives 1a and 1b are provided in Figure 7.

Dissolved Air Flotation - Thickening

Solid particles are separated from the liquid phase by the introduction of fine air bubbles. The bubbles attach to the particulate causing it to rise to the surface where it is removed. The remaining liquid is then recycled to the plant. In a dissolved air flotation system, the air is dissolved in the wastewater under a pressure of several atmospheres. The bubbles form and rise; then the pressure is released to atmospheric level.

Flotation thickeners produce a sludge with approximately 3 to 5 percent solids and 85 percent solids recovery. Addition of polyelectrolytes can increase solids recovery to about 95 percent. Air flotation thickeners remove the small or light particles (including grease) which will remain suspended in a gravity thickening system. The separation process is rapid, so a high-volume system can be constructed in minimal space. In comparison to the other mechanical thickening options studied after the preliminary evaluation, namely centrifuge, the total cost was less along with elimination of a potential odor problem. Other technical nonmonetary and environmental factors were similar for the two.

Dissolved air flotation thickeners require careful maintenance which increases O&M costs. If polyelectrolytes are required, chemical conditioning facilities are necessary. The reliability of flotation thickening is affected by varying sludge characteristics; additionally, a varying product from this process could have deleterious effects on downstream steps.

Anaerobic Digestion - Stabilization

Anaerobic digestion of sewage sludge is currently used at the Des Moines Main Plant. The decomposition of the organic material is carried out by anaerobes in a sealed vessel in the absence of oxygen. The material in the vessel is mixed to maintain a uniform composition. The solids drawn off are further processed while the liquid is recycled through the plant.

Stabilization of sewage sludge by anaerobic digestion becomes increasingly attractive as energy costs escalate. A by-product of the decomposition of organic materials is methane, a medium-energy gas which can be used

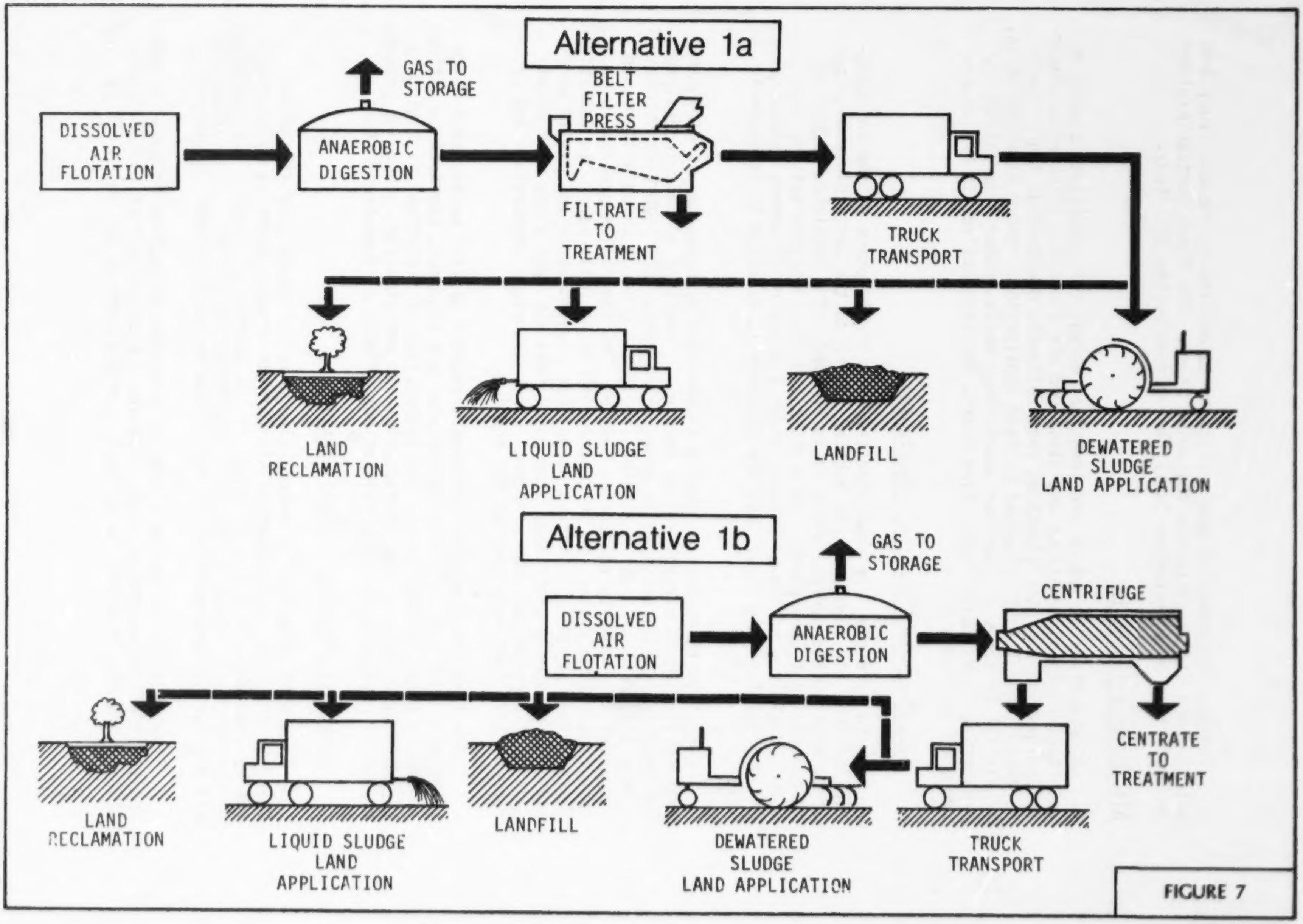

Alternative 1a
DISSOLVED AIR FLOTATION
ANAEROBIC DIGESTION
GAS TO STORAGE
BELT FILTER PRESS
FILTRATE TO TREATMENT
TRUCK TRANSPORT
LAND RECLAMATION
LIQUID SLUDGE LAND APPLICATION
LANDFILL
DEWATERED SLUDGE LAND APPLICATION
Alternative 1b
DISSOLVED AIR FLOTATION
ANAEROBIC DIGESTION
GAS TO STORAGE
CENTRIFUGE
CENTRATE TO TREATMENT
TRUCK TRANSPORT
LAND RECLAMATION
LIQUID SLUDGE LAND APPLICATION
LANDFILL
DEWATERED SLUDGE LAND APPLICATION

FIGURE 7

to heat or produce electricity. The process produces a net increase in energy; the gas produced more than offsets energy required to heat the digester and mix the sludge. The remaining inert sludge is reduced in quantity and is of a better quality than that produced in an aerobic system and has an accepted value as a soil conditioner. Anaerobic digestion significantly reduces the number of pathogenic organisms.

A disadvantage of this process is the sensitivity of the organisms to the digester environment. Fluctuating influent sludge can cause problems. The system, once upset, requires extensive time (in comparison to an aerobic system) to restabilize due to the slow growth rate of anaerobes. Required periodic draining and cleaning of the digesters will also cause this extended disruption of the process. Methane gas, although a valuable by-product, is also an explosion hazard. In addition to the methane, malodorous hydrogen sulfide is also produced.

Belt Filter Press - Dewatering

Alternatives 1a and 1b differ only in the dewatering process. A belt filter press is used for 1a, while 1b uses a centrifuge.

A belt filter press produces a cake by compacting the sludge between two continuous belts. The sludge is chemically conditioned and then dumped on the moving belt where it drains by gravity. This is the first of three zones of operation of the press. The second, the pressure zone, compacts the sludge between the belts to remove more of the water. The final zone further reduces the moisture with shear forces. Again, the liquid removed is recycled to the plant. The cake produced can be expected to have a solids content of 25 percent, and the process has approximately a 95 percent solids recovery.

The area required for belt filter press dewatering is small in comparison to other systems. A high-rate dewatering system can be installed in a small floor area. The belt press performs well on a varying sludge, producing a consistently dry cake if properly operated.

The filter press operation is dependent on the chemical conditioning. This produces the flexibility of the system to varying sludge; and, if operation does not adjust to fluctuations, the belt press will not perform well. Operation of the belt filter press requires continual maintenance due to the large number of moving parts, thus high O&M costs can be expected. Since the operation is enclosed, there is little effect on the environment.

Centrifuge - Dewatering

Centrifuge dewatering spins the sludge to separate the liquid and solid phase. This method has been used to separate materials of different density in industry for many years. The dewatered sludge is further processed and the centrate recycled to the plant.

Centrifuge equipment has one of the lowest total capital costs for sludge dewatering. The installation is simple and does not require extensive construction. Centrifuging does not require that the sludge be chemically conditioned, although performance is enhanced by the addition of polyelectrolytes.

The centrate recycled to the plant is high in suspended solids and can cause operational difficulties in the primary settling system. The maintenance of a centrifuge system can be costly due to high degree of wear. Centrifuges also can produce a noise problem for those working in the plant and on neighboring property. Since centrifuge dewatering is a confined process, outside of the noise, there is little environmental impact.

Truck Transportation - Transport

Trucking the dewatered, stabilized sludge to the ultimate disposal sites provides the system flexibility. Disposal areas can be changed at a low cost. The construction required for truck transportation is minimal, reducing capital cost and negative environmental effects. The capital cost can be further reduced if the trucks are leased and not purchased.

The cost of operation of a truck system continues to rise with increasing fuel costs. This cost escalation is also true of other transportation methods such as rail, but to a lesser degree. The emissions from trucking, dust, and exhaust have deleterious effects on the environment.

Dewatered Sludge Land Application - Ultimate Disposal

Land application is best suited to flat areas and certain types of row crops. Application is a simple process with little more complexity than operation of heavy equipment. Dewatered sludge serves as an excellent soil conditioner being high in essential plant nutrients. High application rates are commonly used to reclaim strip mines and other poor soil areas.

Use of sludge as a soil conditioner for feed crops must be carefully controlled. The potential exists for plant uptake of heavy metals and other industry contributed constituents which could then enter the food chain; however, the Iowa Department of Environmental Quality (IDEQ) regulations limit maximum sludge application and require maintenance of soil pH at or above 6.5. The application of the sludge could spread pathogenic organisms into the environment. The design and operation of the system must prevent the degradation of streams in the area from both runoff and erosion.

Alternative 2

The second alternative designated for further evaluation in the 201 Study is similar to the first. This alternative, however, uses composting for the stabilization process. Alternative 2 starts with dissolved air flotation thickening followed by belt filter press dewatering. These processes will differ slightly from Alternatives 1a and 1b in that the nondigested sludge will have different dewatering characteristics. Composting follows these processes, with the finished product being transported by truck and marketed as a fertilizer as the ultimate disposal method. The remaining processes (air flotation, belt filter press, and truck transport) have been previously detailed. A flow chart for Alternative 2 is shown in Figure 8.

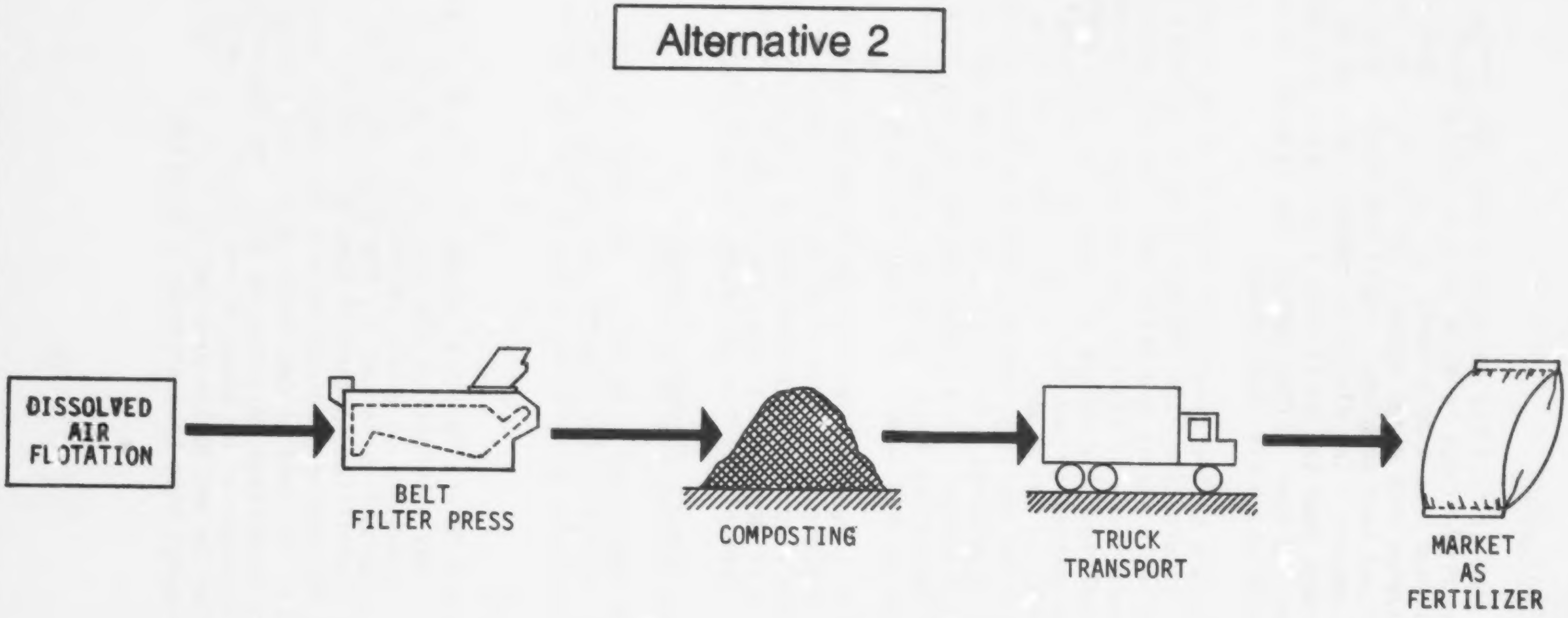

Alternative 2
DISSOLVED AIR FLOTATION
BELT FILTER PRESS
COMPOSTING
TRUCK TRANSPORT
MARKET AS FERTILIZER

FIGURE 8

Composting - Stabilization

An extended air compost facility based on established design criteria is proposed. The dewatered sludge is mixed with a bulking agent (wood chips) and built into long rows atop a series of porous, disposable pipes. The piles are then covered with cured compost and then a layer of wood chips to prevent dust and odor problems. Small compressors draw air through the porous pipes and compost. The sludge is commonly aerated for 21 days. The piles are then broken down and built into a pile where the material cures for an additional 30 days. After curing, the material is screened to remove the wood chips which are then reused.

Composting produces a usable by-product which makes an excellent soil conditioner. In this alternative, the compost is to be marketed as a fertilizer. The process has a simple operation requiring only operation and maintenance of front-end loaders, blowers, and screens. The screened wood chips are reusuable but require a makeup of fresh chips to compensate for lost wood chips. The composting operation requires no additional digestion or chemical conditioning of the sludge. There is no appreciable odor associated with a properly run facility, and the idea has been gaining public acceptance. Composting produces a material with twice the solids content of a dewatered digested sludge. This higher solids content dramatically facilitates both transportation and application. The low moisture content also allows compost to be used as a final cover for landfills.

A large land area is required for the composting facility relative to other stabilization processes. This area should be paved for runoff and leachate collection which can be pumped back to the plant. Additionally, as in land application of dewatered sludge, caution must be used if heavy metals are present to prevent their accumulation in food crops.

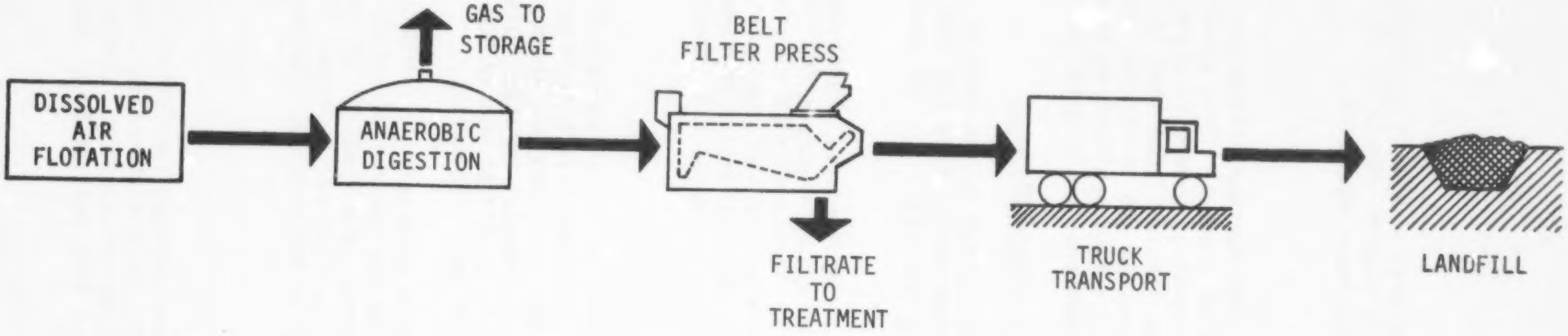
Marketing as Fertilizer - Ultimate Disposal

Marketing of the compost as a fertilizer has shown promise in other areas of the country, primarily for governmental use for parkland or land reclamation projects. Public acceptance of the product is increasing.

Alternatives 3a and 3b

Alternatives 3a and 3b are identical except for the digested sludge dewatering process. These alternatives are similar to 1a and 1b in that 3a uses a belt filter press and 3b uses a centrifuge. The overall processes are also similar to Alternatives 1a and 1b, the only difference being the ultimate disposal is landfilling instead of land application. Alternatives 3a and 3b begin with thickening by dissolved air flotation, stabilization by anaerobic digestion, followed by dewatering with a belt filter press (Alternative 3a) or a centrifuge (Alternative 3b). The dewatered stabilized sludge is then transported by truck to the landfill. Separate flow charts for Alternatives 3a and 3b are provided in Figure 9. Except for landfilling, the processes have been previously detailed.

Alternative 3a


DISSOLVED AIR FLOTATION
ANAEROBIC DIGESTION
GAS TO STORAGE
BELT FILTER PRESS
FILTRATE TO TREATMENT
TRUCK TRANSPORT
LANDFILL

Alternative 3b

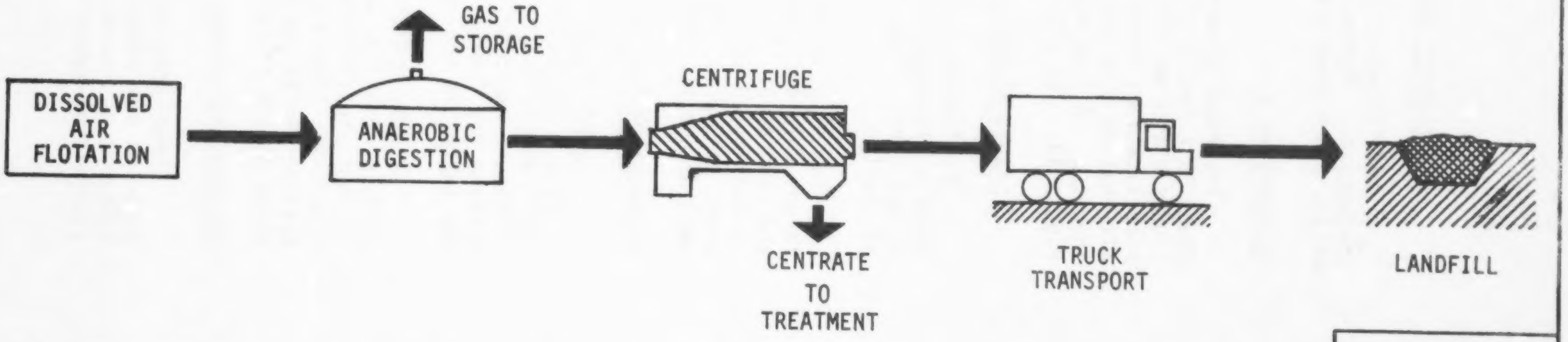

DISSOLVED AIR FLOTATION
ANAEROBIC DIGESTION
GAS TO STORAGE
CENTRIFUGE
CENTRATE TO TREATMENT
TRUCK TRANSPORT
LANDFILL

FIGURE 9

Landfilling - Ultimate Disposal

Landfilling of the stabilized dewatered sludge is a widely used method of disposal. Operation of a landfill is simple, requiring few specialized skills other than the ability to operate heavy equipment.

Alternative 4

The final alternative recommended for further evaluation in the 201 Study is a liquid sludge land application process. This alternative includes dissolved air flotation for thickening, anaerobic digestion for stabilization, truck transport, and the liquid sludge land application. Alternative 4 is the same as Alternatives 1a and 1b without the dewatering step. A flow chart for liquid sludge land application is shown in Figure 10. The other processes have been previously detailed.

Liquid Sludge Land Application - Ultimate Disposal

The liquid sludge land application system is the same as the previously discussed land application system except that the dewatering step is not used. Thus, the facilities and associated cost of dewatering are eliminated.

The elimination of the dewatering step requires the disposal of a larger volume of material. This larger volume requires additional trucks and land area. The higher moisture also increases risk of groundwater contamination and runoff. As with the previous land application alternative, the design and operation must include mitigative measures to prevent damage to streams and other negative environmental impacts.

Alternative Selection

The 201 Study identified Alternative 1a (dissolved air flotation including anaerobic digestion, belt filter press, truck transport, and land application) as the optimum choice. The selection was based on costs, technical nonmonetary factors, and environmental impacts. The use of methane gas from the anaerobic digesters to offset yearly O&M costs was a key factor in the cost effectiveness of this alternative.

Standby options for the recommended alternative, although not previously detailed, were included for the recommended alternative. These options are ultimate disposal of material in a landfill (in the Metro East Landfill), liquid sludge application, or land reclamation. These back-up systems can be used if problems arise in the proposed treatment at any point in the process.

PROPOSED ADDITIONAL ALTERNATIVES

Three additional alternatives are included for further evaluation. Based on processes included in the 201 Study alternatives, they will be examined to ensure all practical options are studied. Continuing the alternative numbering system, they are Alternatives 5, 6, and 7a and 7b.

Alternative 4

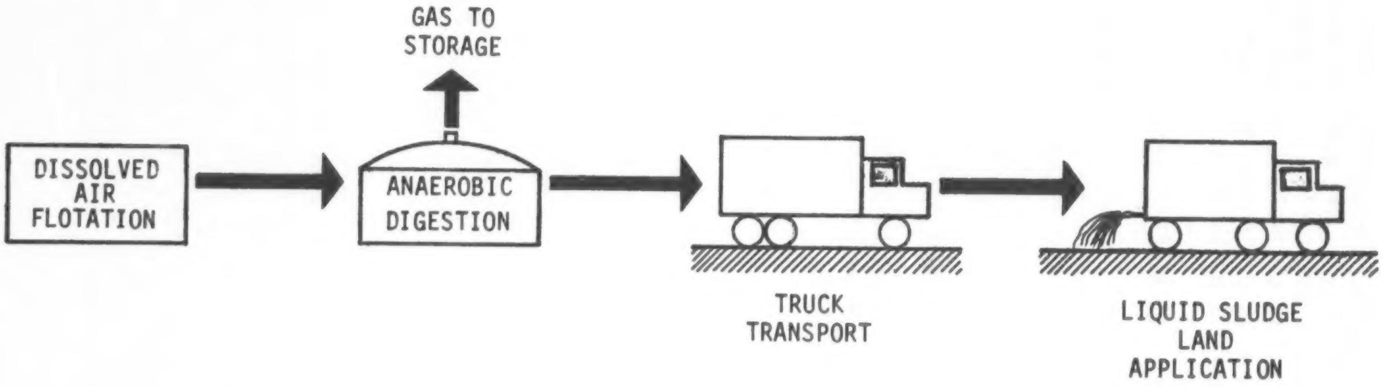

DISSOLVED AIR FLOTATION
GAS TO STORAGE
ANAEROBIC DIGESTION
TRUCK TRANSPORT
LIQUID SLUDGE LAND APPLICATION

FIGURE 10

Alternative 5

Alternative 5 is another composting system. As in Alternative 2, the extended aeration composting is preceded by dissolved air flotation thickening and belt filter press dewatering. The alternative differs from the previous composting system in ultimate disposal (land reclamation). A flow chart for Alternative 5 is presented in Figure 11. Dissolved air flotation and composting have been previously detailed.

Land Reclamation - Ultimate Disposal

Reclamation of the strip mines is the proposed ultimate disposal of the sludge compost. The strip mine can be turned into usable land by filling and mixing with compost and planting vegetation. Compost can serve as the intermediate and final cover for the project, with vegetation planted directly on it. No additional topsoil is required. Land reclamation projects provide a long-term commitment for disposal compared to dependence on individual farmers in land application systems.

Mitigative measures must be taken to ensure runoff from the project does not enter and degrade streams in the area. Provisions must also be made to protect groundwater.

Alternative 5 includes back-up for the normal operation. This involves use of truck transportation to the Metro East Landfill.

Alternative 6

Alternative 6 is another composting system. It too uses dissolved air flotation for thickening and a belt filter press for dewatering. Following the extended air composting is truck hauling to the Metro East Landfill. Alternative 6 is the same as the back-up for the previous system. The processes under this alternative have been detailed under Alternatives 1, 2, and 3a and 3b. Again, as in land reclamation, compost does not require an additional intermediate and final cover. A flow chart for Alternative 6 is provided in Figure 12.

Alternatives 7a and 7b

Alternatives 7a and 7b are land reclamation systems using anaerobically digested sludge. The systems begin with dissolved air flotation followed by the anaerobic digestion step. As in Alternatives 1a and 1b and Alternatives 3a and 3b, the difference in systems is the dewatering - in 7a by belt filter press and in 7b by centrifuge. After the dewatering, the digested sludge is hauled by truck to the land reclamation site. A flow chart of this system is presented in Figure 13. The steps have been previously detailed in Alternatives 1a and 1b and Alternative 5. Land reclamation by stabilized sludge will differ from the compost system.

Alternative 5

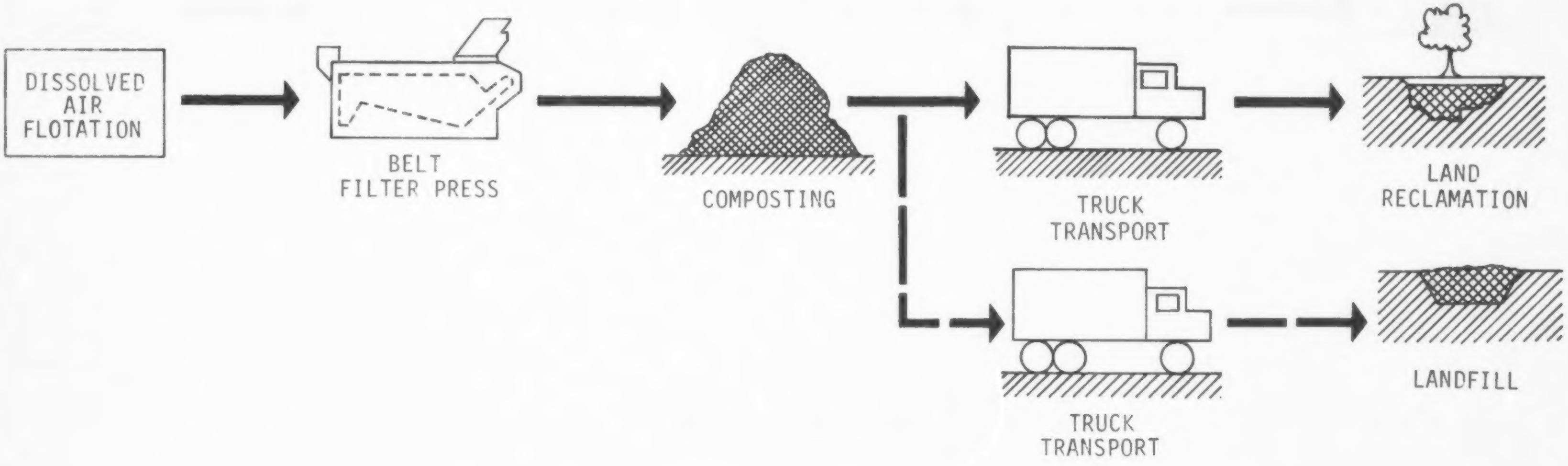

DISSOLVED AIR FLOTATION
BELT FILTER PRESS
COMPOSTING
TRUCK TRANSPORT
LAND RECLAMATION
TRUCK TRANSPORT
LANDFILL

FIGURE 11

Alternative 6

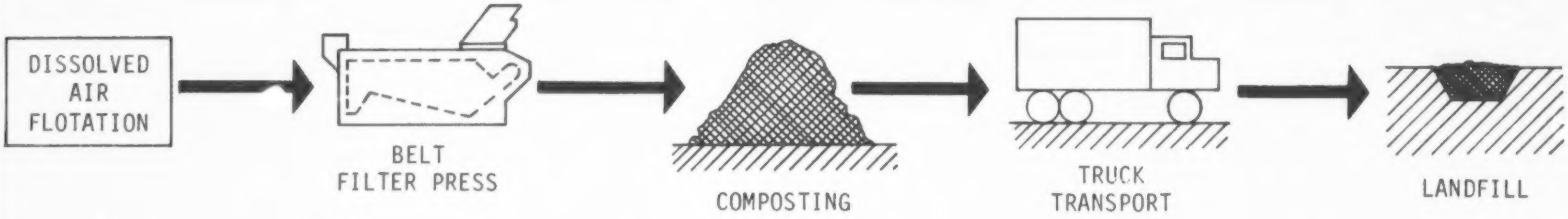

DISSOLVED AIR FLOTATION
BELT FILTER PRESS
COMPOSTING
TRUCK TRANSPORT
LANDFILL

FIGURE 12

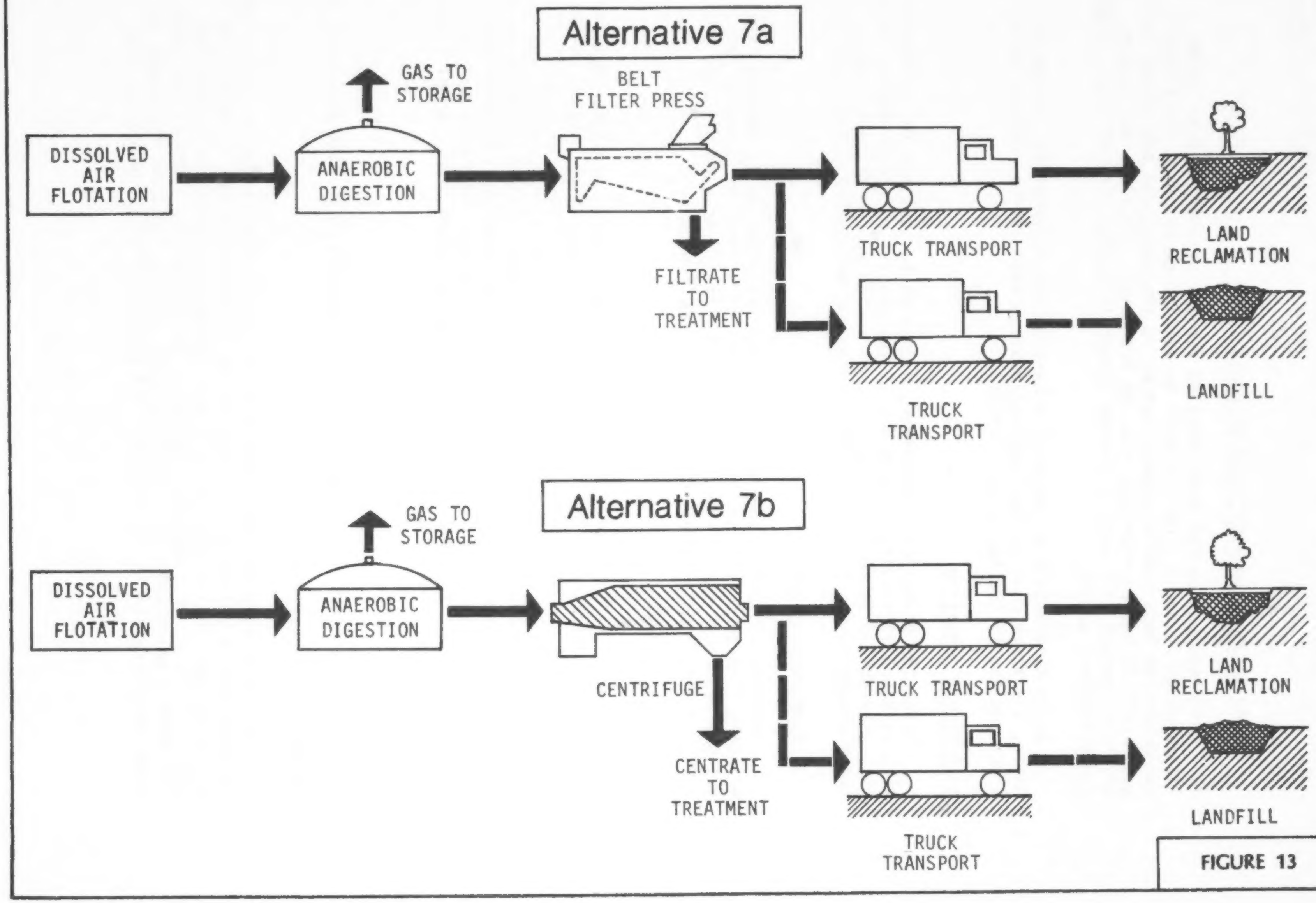

Alternative 7a
DISSOLVED AIR FLOTATION
ANAEROBIC DIGESTION
GAS TO STORAGE
BELT FILTER PRESS
FILTRATE TO TREATMENT
TRUCK TRANSPORT
LAND RECLAMATION
TRUCK TRANSPORT
LANDFILL
Alternative 7b
DISSOLVED AIR FLOTATION
ANAEROBIC DIGESTION
GAS TO STORAGE
CENTRIFUGE
CENTRATE TO TREATMENT
TRUCK TRANSPORT
LAND RECLAMATION
TRUCK TRANSPORT
LANDFILL

FIGURE 13

Land Reclamation - Ultimate Disposal

Land reclamation has been detailed for the compost system. Under Alternatives 7a and 7b, results will be similar except that the sludge would provide less stable organic matter to the area; and additional soil would need to be incorporated into the top cover. Finally, the higher moisture content will pose a greater danger to surface (runoff) and ground (infiltration) waters.

As in Alternative 5, there is a back-up for Alternatives 7a and 7b. Again, the truck haul to the land reclamation area can be replaced with truck hauling to the Metro East Landfill.

No-Action Alternative

Under the No-Action Alternative, sludge would continue to be handled with existing facilities. These facilities consist of single-stage, high-rate anaerobic digesters followed by coil spring vacuum filters. Dewatered sludge in the truck is hauled to the Des Moines Metro East Landfill.

Anaerobic Digestion

Anaerobic digestion was described under Alternative 1; however, the existing digesters lack equipment for cleaning the gas produced or provisions for recycling the gas within the facility. As a result, gas produced by the process is now vented to the atmosphere.

Vacuum Filter

Vacuum filters are presently the most common means of sludge dewatering. A vacuum filter is basically a cylindrical drum that rotates partially submerged in a pan of sludge. A vacuum is applied within the drum causing the filtrate to be extracted and the filter cake to be retained on the drum surface. In general, vacuum filtration will produce sludge cakes of 18 to 20 percent solids, although actual efficiency is dependent on individual sludge characteristics. Because cake solids are less than what can be achieved with the methods used for the proposed alternatives, total sludge for disposal will be greater.

Disposal

Truck transport and landfilling were covered in Alternatives 1 and 3.

COMPARISON OF SYSTEM ALTERNATIVES

In considering the work performed by the 201 consultant, a useful perspective can be gained by focusing on the disposal element of each alternative because this element of a sludge management system will have the most significant environmental impact. The processing alternatives generally have a relatively small environmental impact; the most important inplant consideration is the selection of a combination of processes that will efficiently and economically produce a treated sludge with the requisite characteristics for each particular disposal mode. Thus, the comparison of sludge management alternatives for the Des Moines Main Plant system has as its focus the disposal elements of the alternatives.

Sludge Processing

Five distinct sludge processing trains are used within the seven sludge management alternatives and the No-Action Alternative. These process trains and the key evaluation criteria for each are presented in Table 16.

Alternatives 1a, 3a, and 7a utilize dissolved air flotation, anaerobic digestion, and belt filter press dewatering. Additional area requirements would be limited to providing four additional anaerobic digesters, or less than one-half acre adjacent to the existing digesters. None of the three processes are highly labor intensive; although, to perform properly, the anaerobic digestion process must be carefully monitored. All three processes are well proven and reliable. Cost based on estimates from the 201 Facilities Plan would be $27.5 million on a present worth basis. Sludge for disposal would amount to 200 cubic yards per day.

Alternatives 1b, 3b, and 7b differ from the previous alternatives only by using centrifuge dewatering rather than belt press dewatering. Area requirements, O&M requirements, reliability, and sludge generated for disposal would all be similar. The present worth at $28 million would be slightly higher.

The process train for Alternative 4 is also similar to the ones described above except no dewatering step is provided. As a result, while the present worth cost drops to $20.5 million, a total of 325,000 gallons of sludge must be disposed of daily.

Alternatives 2, 5, and 6 utilize dissolved air flotation, belt filter press dewatering, and aerated pile composting. To accommodate the composting step, an additional 15 acres would be required. Additionally, as the process is highly labor and material intensive, O&M requirements are high. While the process is relatively simple, there has been limited experience with it at a large scale, thus making reliability uncertain. Present worth costs are estimated to be $25.5 million, and 250 cubic yards of compost would be generated daily.

The No-Action Alternative, which uses anaerobic digestion and a vacuum filter, is similar to the other alternatives using anaerobic digestion. No additional area would be used. O&M requirements are moderate; system reliability is good, although performance of the digesters and vacuum filter would not be as good. Because the solids content of the sludge would be lower, 250 cubic yards of sludge would be generated daily. Present worth cost to continue with this option would be $11 million.

TABLE 16

COMPARISON OF ALTERNATIVES - SLUDGE PROCESSING

Alternative	Criteria				
	Additional Area Requirements	O&M Requirements	System Reliability	Present Worth Cost ($ x 10^6)	Material Requiring Disposal
Alternatives 1a, 3a, 7a Dissolved air flotation Anaerobic digestion Belt filter press	None	Moderate	Good	27.5	200 cu yd/day (180 ton/day)
Alternatives 1b, 3b, 7b Dissolved air flotation Anaerobic digestion Centrifuge	None	Moderate	Good	28.0	200 cu yd/day (180 ton/day)
Alternative 4 Dissolved air flotation Anaerobic digestion	None	Moderate	Good	20.5	325,000 gal/day (1,400 ton/day)
Alternatives 2, 5, 6 Dissolved air flotation Belt filter press Aerated pile composting	15 acres	High	Undocumented	25.5	250 cu yd/day (135 ton/day)
No-Action Alternative Anaerobic digestion Vacuum filter	None	Moderate	Good	11.0	250 cu yd/day (255 ton/day)

Sludge Disposal

Seven separate sludge disposal methods are used for the proposed alternatives and the No-Action Alternative. These methods and key evaluation criteria for each are presented in Table 17.

For Alternative 1, truck transport of dewatered sludge to land application, 4,100 acres of land would be required each year based on an application rate of 4 dry tons of sludge per acre. Storage at the treatment plant could be provided in the present drying beds, but 3 acres of off-plant storage would be required. Land application and the truck transport would result in a moderate O&M requirement. Process reliability is good, but weather and lack of dedicated disposal sites would reduce overall reliability. Present worth cost is estimated to be $2.5 million.

For Alternative 2, marketing compost as a fertilizer, no additional land would be required for disposal or storage. O&M requirements would be low. Reliability, however, is uncertain and would be based on developing an adequate market. Present worth cost is estimated to be $1.5 million.

Both Alternative 3 and the No-Action Alternative use truck transport and landfill disposal of dewatered sludge. Assuming that the Metro East Landfill continues to be used, no additional land would be required. Also, no storage on an off site would be needed. O&M requirements are low, and reliability is good. Present worth cost, again assuming continued use of the Metro East Landfill, is $1.5 million.

For Alternative 4, truck transport and liquid sludge land application, 4,100 acres would, like Alternative 1, be required per year. Storage requirements, however, would be 30 million gallons which would have to be provided at the treatment plant at several remote locations. As a result of the large volume of sludge to be disposed of, O&M requirements would be high. Reliability is expected to be low. Present worth cost would be $6.0 million.

For Alternative 5, truck transport and land application of compost, only 275 acres per year would be required as metals limitations, not nitrogen requirements, would define the allowable application rate. No on-plant storage would be required, but 4 acres of transfer storage at the reclamation site would be needed. Extensive grading would be required at the reclamation site so O&M requirements would be high. System reliability would be high as no specialized application equipment would be needed. Present worth cost is estimated to be $1.5 million.

Alternative 6 is similar to Alternative 3 and the No-Action Alternative except compost rather than dewatered sludge is disposed of in the landfill. Criteria would be the same; however, incorporation into the landfill would be simpler since the sludge would be dryer and more stable.

Alternative 7 is similar to Alternative 5 except that dewatered sludge rather than compost is used. The criteria would be the same; although be-

TABLE 17

COMPARISON OF ALTERNATIVES - DISPOSAL

	Criteria				
Alternative	Annual Land Requirement	Storage Requirement	O&M Requirements	Reliability	Present Worth Cost ($ x 10^6)
Alternative 1 Truck transport Dewatered sludge Land application	4,100 acres	3 acres	Moderate	Fair	2.5
Alternative 2 Truck transport Market compost as fertilizer	None	4 acres	Low	Uncertain	1.5
Alternative 3 and No-Action Alternative Truck transport Landfill dewatered Sludge	None	None	Low	Good	1.5
Alternative 4 Truck transport Liquid sludge Land application	4,180 acres	30 mil gal	High	Poor	6.0
Alternative 5 Truck transport Compost Land reclamation	660 acres	4 acres	High	Good	1.5
Alternative 6 Truck transport Landfill compost	None	None	Low	Good	1.5
Alternative 7 Truck transport Dewatered sludge Land reclamation	660 acres	4 acres	High	Good	1.5

cause specialized application equipment would be required, O&M requirements would be slightly higher and reliability would be slightly lower.

INSTITUTIONAL ALTERNATIVES

The National Environmental Policy Act (NEPA) requires every federal agency to prepare a detailed statement on environmental impact for each of its major proposed actions significantly affecting the environment. In this case, a 201 Facilities Plan was prepared which includes the processing and disposal of sludge by the Des Moines Main Treatment Plant. Under Title II of the Water Pollution Control Act Amendments, EPA is given authority to distribute construction grant fundings for municipal wastewater treatment facilities. This section of the Act defines a three-step process of planning (Step I), design (Step II), and construction (Step III) that must be fulfilled for an eligible grant applicant to construct a facility with federal funds. Design (Step II) review is delegated to the state. EPA has determined that the approval process of a Facilities Plan constitutes the federal action under NEPA.

Sludge treatment and disposal units are considered an integral part of the wastewater treatment process and hence are eligible for funding. Section 212(A) of the Act defines such facilities to include land acquisition costs if they are part of the treatment process:

> "The term 'treatment works' means any devices and systems used in the storage, treatment, recycling, and reclamation of municipal sewage or industrial wastes of a liquid nature. . .including site acquisition of the land that will be an integral part of the treatment process or is used for the ultimate disposal of residues resulting from such treatment."

In reviewing the recommended alternative, EPA has three options:

- Award additional grants for the design of the facility as recommended in the Facilities Plan
- Award additional grants for the design of a modified Facility Plan
- Deny future grants

In reviewing the Facilities Plan, the initial consideration must be whether or not the proposed actions are in response to a demonstrable need. Specifically, are there specific negative impacts associated with the No-Action Alternative which justify future action? Where such impacts cannot be demonstrated, then the denying of the future grants is the option to be pursued.

Based on the assumption that environmental impacts, operational impacts, or economic impacts associated with the existing system have been demonstrated, then award of additional grants to rectify these problems would be expected. Recognizing the effort that has been invested in the 201 Facilities Plan, the recommended alternative would be the prime candidate unless it can be demonstrated that there are significant environmental or other objections to the recommended system. If so, it would be assumed that grants would be provided for facility modifications based on use of a different treatment system.

In reviewing the proposed alternatives, it must be kept in mind that actions by other agencies will have an impact on implementation of the selected alternative. For the land disposal of the stabilized sludge or compost by either landfilling, high-rate land application, or land reclamation, a disposal site permit will have to be secured from the Iowa Department of Environmental Quality. If sludges are to continue to be disposed at the Metro East Landfill (as proposed under the No Action Alternative and Alternatives 3 and 6), IDEQ would most likely reevaluate that disposal facility's existing permit and possibly impose additional restrictions relating to sludge acceptance and sludge characteristics as well as site design and operational standards. Thus, their actions could limit or define possible alternatives. Additionally, where disposal occurs outside the ICA, agreement will have to be secured from the community prior to disposal, again limiting possible disposal options.

CHAPTER IV

ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVES ON THE AFFECTED ENVIRONMENT

INTRODUCTION

This chapter is the core of the EIS. It is here that the impacts of the preferred action (Alternative 1a) and the other considered project alternatives are presented and discussed.

Because of the highly site-specific nature of the impacts and because specific sites for land application and mine reclamation have not yet been selected, the impacts are presented first as a general discussion followed by site-specific impacts upon the representative or typical sites selected for detailed analysis. It should be noted that a brief environmental assessment will be performed and reviewed by the Iowa Department of Environmental Quality for each site ultimately chosen for land application or land reclamation.

This chapter is organized by subject heading (i.e., soils, surface water, air quality, etc.), with the impacts of each project alternative discussed under the subject heading. Impacts of the No-Action Alternative are presented first so that relationships of beneficial and adverse impacts between the alternatives and doing nothing can be made. This format allows for easy comparison of impacts between project alternatives for any particular environmental parameter. In certain areas where no discernable difference exists between individual project alternatives, a general impacts discussion is presented or impacts of alternative groupings are presented. This is done in the interest of brevity and to avoid redundancy.

ECOLOGICAL ENVIRONMENT

70a-

AQUATIC FLORA AND FAUNA

Adverse impacts to aquatic biota from a sludge disposal program result from runoff into streams, rivers, ponds, or lakes. The potential changes occur during periods of heavy rain when surface runoff and floods sweep material into the waters. The major effect on water quality is from elevated limiting nutrient levels, especially nitrates and phosphates. Raising limiting nutrient levels stimulates aquatic plant growth, including algaes. Increased algal growth will drive down ambient dissolved oxygen levels during the respiration phase of the diurnal growth cycle. The increased biomass of the algae also provides more organic material to be oxidized by bacteria. This will also deplete available dissolved oxygen. A reduced oxygen concentration is detrimental to resident animal species requiring high (near saturation) levels of dissolved oxygen such as many game fish. Excessive nutrient addition can thus deplete the available oxygen so that only a few species can survive. The extreme result of this repeating cycle is eutrophication and the death of the waterbody.

A second adverse impact from runoff into water is from settleable and suspended solids. Settleable solids will cause siltation problems similar to runoff from plowed fields. The solids can cover eggs and breeding and feeding areas. Suspended solids in the water block sunlight necessary for photosynthesis, stopping the release of oxygen, a by-product of the process. The result is again lowering of ambient dissolved oxygen levels.

Addition of biochemical oxygen demand (BOD) and the corresponding dissolved oxygen depletion is not a significant potential impact. Digested sludge is relatively inert with a low BOD value.

Land Application (Alternatives 1 and 4)

Land application of the sludge as either a liquid or dewatered cake has potential significant runoff impacts if not properly managed. To avoid problems, application sites must be carefully screened. Sloped areas near streams, rivers, ponds, or lakes and areas on floodplains cannot be used. Elevated nitrate and suspended solids are already reported by the Des Moines Water Plant during fall and spring fertilizing/tilling times. Fall and spring are the periods of heavy rain and runoff.

At the three representative land application sites, varying potential for affecting the aquatic biota exists. Thus, the potential impacts are presented separately below.

Site 1 - Polk County

A large stock pond is located in the middle of one potential land application area. Natural drainage patterns direct runoff to this stock pond around which a natural vegetation buffer is maintained to protect against adverse impacts. While any runoff would be expected to contain elevated nitrate levels, such nitrate concentrations are not considered dangerously high under present fertilization practices. Further, it is unlikely that nitrate or other adverse impacts would be significantly different with sludge application than exists from present fertilization practices.

Site 2 - Warren County

A small intermittent stream that is tributary to the Middle River runs through the site, and part of the site is bounded by the Middle River. Slopes in this area of the site are minimal, however, so runoff should be limited. Of greater concern is the fact that much of the site lies in the floodplain of the Middle River. Thus, there exists the potential for direct transfer of material during floods.

Site 3 - Warren County

Squaw Creek is located at the base of this site. As slopes through the site are great and there is essentially no vegetative buffer remaining along the creek, a significant potential for runoff exists.

Marketing of Compost (Alternative 2)

Marketing composted sludge as a fertilizer will not affect aquatic biota, assuming the compost facility is properly sited and runoff is collected and treated.

Landfilling (No-Action Alternative and Alternatives 3 and 6)

The Metro East Landfill presently has no runoff problems nor is it in a floodplain. Continued landfilling of sludge as a dewatered cake or compost will have no effect on aquatic flora and fauna.

Land Reclamation (Alternatives 5 and 7)

The numerous small drainage ponds in abandoned strip mines are very acidic and devoid of life. Filling these in would, therefore, harm no aquatic biota. Caution must be used in selection of mines to be reclaimed. Runoff from the area could enter nearby streams, and floodwaters could sweep the sludge or sludge compost into swollen rivers or lakes. The representative site (Site 5) exemplifies this situation. The mine lies in the floodplain of Red Rock Reservoir. A major flood could carry deposited material from the mine into the reservoir, causing adverse impacts as previously noted.

TERRESTRIAL FLORA AND FAUNA

Land Application (Alternatives 1 and 4)

The sites where sludge would be land applied would be existing farmland and, as such, are presently under cultivation and contain no native vegetation. In general, the sludge should have a beneficial effect on plant growth by supplying all or part of the essential plant nutrients. There is the potential that excess application of heavy metals could result in a long-term reduction of soil productivity due to phototoxicity. Weed control could be a major problem. The presence of weeds associated with sludge application is due to the viability of seeds of many crops in and through the human digestive system and the wastewater and sludge treatment processes.

Insect populations and scavenging wildlife may constitute a problem on sludge-amended farms (farms on which sludge has been applied), depending on the type of crop grown. Large stands of monoculture (one crop) represent a greatly simplified ecosystem with a preponderance of only a few insect and animal species.

Direct effects of the sludge application on wildlife would be few and generally limited to spring and fall. Bird species which forage on the ground, feeding on terrestrial insects and seeds, would be exposed to the sludge mixture. Heavy metals or other sludge constituents accumulated by insects could be further concentrated by the bird population.

Vectors such as gnats, flies, and mosquitoes are expected to be present in the vicinity of the remote storage areas. While gnats and flies will remain within 1/2 mile, mosquitoes can travel up to 25 miles. Vectors in the vicinity of the sludge storage areas would have a particularly significant impact.

Although all three land application sites are presently intensively cultivated, small areas of undisturbed habitat exist at Sites 1 and 2 around stock ponds; however, it is unlikely that these areas would be affected by land application.

As a result of the present hog farming, a heavy fly population presently exists at Site 2. Application of sludge could increase this population, as discussed previously.

Marketing of Compost (Alternative 2)

Application of compost to parkland or farmland should have a beneficial impact by stimulating plant growth. Compost contains elements essential to plant growth and also improves soil texture. Adverse impacts could result from application rates in excess of recommended levels.

As application of compost would be generally in the spring and late fall, effects on wildlife would be limited. Bird species which forage on the ground and feed on terrestrial insects and seeds would be most exposed to the compost. While such animals may be exposed to a slight concentration of sludge components along the food chain, the application areas will be small so the impact will be limited.

Landfilling (No-Action Alternative and Alternatives 3 and 6)

Landfilling will destroy existing habitats during the life of the landfill and can attract various vectors. For all alternatives, the existing landfill would be used so the additional impact would be minimal. At the present Metro East Landfill, no insects, birds, or rodents were noted.

Land Reclamation (Alternatives 5 and 7)

The application of compost or sludge to abandoned mine land will have a very beneficial impact on vegetation. Mine spoil sites are typically devoid of a substrate capable of supporting plant growth, and the land application of compost or sludge would essentially be a soil building process.

The establishment of a ground cover would probably follow the basic pattern of plant succession. Hardy pioneer species would first become established and would slowly build up the depth of the soil profile over time through decomposition of dead material, thus permitting the growth and establishment of a more diverse plant community.

Plant succession is generally an extremely slow process. The rate of succession would depend on such factors as the amount of sludge or compost applied and the types of plant species initially planted. Grasses are relatively easily established, but they do not provide large amounts of organic material to be decomposed. Some native shrubs might be planted with some success. These would provide more substantial amounts of detritus in the form of leaf litter than would grasses, although their rates of growth might be inhibited at first by the penetration of the roots deeper into the soil profile. Trees might also be planted, although the penetration of their roots through the top layer into the coarse and acidic spoils might limit their growth potential for many years.

Because the total amount of sludge solids to be applied is relatively low, the uptake of hazardous heavy metals, such as cadmium, zinc, copper, and nickel, should not present problems to plant growth. Plant growth might be inhibited, however, by the uptake of heavy metals present in the underlying spoil material, although this situation should be alleviated over time as the soil profile increases in depth.

The establishment of a complete ground cover of vegetation is highly desirable since it can result in 1) earlier soil stabilization and reduction of erosion; 2) earlier mitigation of acid drainage in surface runoff through increased water holding capacity and through increased water use by evapotranspiration; 3) acceleration of the accumulation of organic residues which will chelate or otherwise make unavailable the soluble iron, manganese, and aluminum. Organic residues also provide the necessary seedbed for plant germination.

Mine spoil areas are typically rocky, barren, and devoid of normal signs of life. Application of sludge with incorporated wood residues would be an initial step toward the reclamation of these wastelands. The successful establishment of vegetation over a period of time would help to restore some of the habitat destroyed by mining activities.

Wildlife habitat would be minimal due to the severity of the terrain and presence of limited types of vegetation. However, the distinct transition from forested slopes to a broad open swale with grass and shrub vegetation would provide an "edge" habitat favorable to wildlife. Animals feeding on vegetation in the reclaimed mine spoils area are subject to accumulations of trace elements.

PHYSICAL ENVIRONMENT

TOPOGRAPHY

In general, the proposed alterations could have essentially no impact on existing topography either at the Des Moines Main Treatment Plant or at the sludge disposal sites. Thus, only those alternatives that would have an impact are addressed.

Composting (Alternatives 2, 5, and 6)

While anaerobic digestion could utilize the existing digesters at the Des Moines Main Plant and, thus, would not require any additional area, composting would require that a paved area of approximately 15 acres be provided. This area, which would cover the existing sludge drying beds and the area adjacent to the sludge drying beds, would have to be graded level and protected against flooding. As the proposed area is already essentially level, the necessary grading would have a minimal impact.

Land Reclamation (Alternatives 5 and 7)

As part of the land reclamation process, the spoil banks at the reclamation sites would be partially levelled and brought to a state where topography at the sites approximated existing contours. This change would reduce the erosion potential of the sites and allow the sites to be returned to beneficial use.

GEOLOGY

Only land reclamation among the proposed alternatives would have any impact on the existing geology. At the reclamation sites, the coal bearing strata would be recovered with the spoil material and compost or sludge. This action would have a net positive impact in that oxidation-induced acid drainage problems would be eliminated at the reclamation sites.

SOILS

Both anaerobically digested sewage sludge and compost contain stable humus-like organic compounds which resist decomposition. These molecules, when well incorporated into the soil, tend to bring about changes in soil structure which have long-term beneficial effects upon the physical properties of the soil.

The principal change occurring as a consequence of organic matter additions to the soil is the gradual formation of a loose, friable soil structure. Increased organic content reduces the possibility of formation of shrinkage cracks in clay soils and gives a more cohesive character to sandy soils. Epstein (1975) found a doubling of the percent of stable aggregates in a soil amended with sludge over a period of 175 days. Organic matter increases the water-holding capacity of the soil; organic soils can retain more than their own weight of water against gravity drainage, while a sandy loam soil may hold less than ten percent water.

Formation of stable aggregates, discussed above, helps increase soil resistance to both wind and water erosion. Additions of sludge over a number of years gradually reduces soil erodibility. Many of the soils in the Des Moines area are naturally moderately erodible in the absence of plant cover. Over the years, sludge application could significantly reduce soil erodibility in these areas.

The application of sludge solids to land should not significantly alter the chemical characteristics of the soil. While harmful accumulations of heavy metals is a potential problem, by maintaining a soil pH of 6.5 and limiting the life of application sites based on cation exchange capacity (CEC) and sludge heavy metals concentrations as required by Iowa Department of Environmental Quality regulations, heavy metal accumulation should not be a problem.

Land Application (Alternatives 1 and 4)

Under the proposed alternatives, sludge will be applied to existing agricultural land. As such, no previously undisturbed land would be affected by the land application alternatives; and, thus, no increase in soil erosion potential should result from the land application alternatives.

While sludge has the potential of improving the structure of soil, at the planned application rates of 4 to 8 dry tons per acre per year, the resulting improvement should be limited. The amount of organic matter contributed will average 0.1 to 0.2 percent of the plow layer mass per year, depending on the crop. Thus, no major improvement in soil physical conditions should occur.

Both the dewatered sludge and liquid sludge land application alternatives would require construction of remote storage sites. The storage sites for the dewatered sludge alternative which are projected to total 3 acres would require limited site grading and construction and so may have a short-term impact on soil erodibility. Remote storage of the liquid sludge will require lagoons with a capacity of 30 million gallons which will cover an estimated 80 acres. The excavation of the land for these lagoons would effectively disturb all soil in a large area. While the disturbed soil would remain at the site, soil characteristics would be modified or destroyed. As a result, a significant increase in soil erosion over the life of each lagoon could be expected.

At all three of the sites visited, the upland soils generally were of Class III e, indicating a moderate erosion potential. Applied at the planned agronomic rates, the added organic matter should, as indicated, have at best a limited effect on soil texture and, thus, would have a limited impact on erodibility.

The operating life of each land application site would be limited by IDEQ regulations to ensure that harmful accumulations of heavy metals in the soil were prevented. Based on maximum cumulative heavy metal loads allowed by IDEQ (Des Moines 201 - Appendix Q) and typical heavy metal concentrations in Des Moines sludge (Table 19), site life was calculated based on an annual application rate of 4.0 tons per acre. Results are presented in Table 18. Based on these calculations, the estimated site life, assuming a CEC of between 5 and 15 meq/100 g, would be 30 years.

Marketing of Compost (Alternative 2)

Marketing of compost would result in the compost being used at a large number of isolated locations primarily as a topsoil or soil amendment. At application rates of between 1,000 and 5,000 pounds per 1,000 square feet, compost would act to improve the physical properties of soil at the sites it was applied. The application areas, however, would generally not exceed 5 to 10 acres so the improvements would be limited in scope.

Landfilling (No-Action Alternative and Alternatives 3 and 6)

Where sludge or compost is disposed of in a landfill with municipal waste, there will be no direct impact on soil erosion. Where compost is used as daily cover for the landfill cells, an indirect benefit is achieved in that natural soil that would have had to be used and, thus, lost is saved. Moreover, once the landfill is closed, compost can be used as part of the final cover, limiting the need for additional topsoil and increasing the quality of the soil cover. By improving the quality of the landfill cover, plant growth should be enhanced and soil erosion limited.

At the Metro East Landfill, sludge is now being mixed with solid waste; and adjacent soil is used as daily cover. As such, there is no resulting impact on soil erosion other than the loss of the soil that must be used as daily cover.

Land Reclamation (Alternatives 5 and 7)

Lacking any vegetative cover and having steep slide slopes, abandoned mines are especially prone to erosion. However, the eroded material tends to be mine spoils rather than productive soil. As such, application of compost, especially, and, to a lesser degree, sludge would have several beneficial impacts relative to soil erosion.

Applying composted sludge has been shown to significant aid in the reclamation and revegetation of land disturbed by surface mining. By using high application rates of compost, adequate soil texture and nutrient addition can be achieved to establish a ground cover of process or other crops (SEA, 1979). With the establishment of this ground cover, subsequent erosion can be significantly reduced.

Sludge application would have a similar effect, although its higher moisture content would limit application and require incorporation with productive soil. Sludge application would also require initial mulching of the area to control erosion until adequate ground cover had developed.

TABLE 18

CALCULATED SITE LIFE BASED ON MAXIMUM CUMULATIVE METAL LOADS

	Typical Metal Concentration (dry weight)		Maximum Land Application Site Life (years) Soil Cation Exchange Capacity (meq/100 g)			Maximum Land Reclamation Site Life (years) Soil Cation Exchange Capacity (meq/100 g)		
Metal	mg/kg	lbs/ton	<5	5-15	>15	<5	5-15	>15
Lead	670	1.34	93	186	372	7.5	15	30
Zinc	2,100	4.20	15	30	60	1.2	2.4	4.8
Copper	500	1.00	31	62	124	2.5	5.0	10
Nickel	230	0.46	68	136	272	5.4	11	22
Cadmium	21.5	0.04	29	58	116	2.5	5.0	10

The operating life of each land reclamation site would also be by IDEQ limitations on maximum cumulative heavy metal loads. Based on an annual application rate of 50 tons per acre, land reclamation site life was also calculated and is also presented in Table 18. Based on these calculations, the estimated site life, assuming a CEC of between 5 and 15 meq/100 g, would be 2 years.

In the abandoned mine area that was visited (Site 5), there was essentially no remaining topsoil and no vegetative cover. Erosion of the spoil banks was extensive, with deep erosion gullies throughout the mine area. Any effort to reclaim the area would result in a net positive environmental impact.

GROUNDWATER

Groundwater serves as an important source of potable water for many cities and communities within central Iowa. This groundwater generally comes from surface alluvial aquifers, as deeper aquifers are high in dissolved solids. The depth of these surficial aquifers is generally relatively shallow and, in many areas, approaches ground level during wet periods.

Potential water quality hazards posed by sludge and compost are pathogens, nitrates, and toxic heavy metals, all of which can be leached from the sludge and compost through the soil column to the groundwater. Pathogen contamination can result from inadequate stabilization of the sludge or compost prior to land application. The impact would primarily be localized and of limited duration, however. Nitrate contamination of groundwater results from the application of an excess supply of nitrogenous compounds over and above the amount which plants can take up and which denitrifying bacteria in the soil can denitrify. Heavy metal contamination results from the application of heavy metals at amounts greater than can be bound up in the surrounding soil structure. To control this problem, IDEQ regulations require that soil pH is to be maintained at or about 6.5.

Land Application (Alternatives 1 and 4)

The potential for groundwater contamination is particularly great for land application. Sludge will be spread over large areas and relatively near to existing wells. High bacterial levels noted in available well analyses for Polk County indicate the potential for localized pathogen contamination. Likewise, increased nitrate levels in the city of Des Moines drinking water supply during the spring indicate the potential for nitrate contamination.

Nitrate contamination in land application areas can also occur as a result of excess nitrogen application by the site owner. Being uncertain of the nitrogen content of the sludge, farmers will supplement with additional nitrogen, resulting in an excess application of nitrogen.

Heavy metal contamination will have a minimal impact for land application. Expected application rates and limitations imposed on cumulative sludge applications will prevent heavy metals levels exceeding the retention capacity of the soil.

The groundwater impact from land application of liquid sludge can be expected to be higher than for dewatered sludge. This greater impact results from the higher moisture content of the sludge and the difficulty of evenly distributing the sludge.

The remote storage sites needed for the land application alternatives constitute a more significant potential for groundwater contamination. Runoff or direct leaching from the piles of dewatered sludge at the storage site could carry bacteria, nitrates, and heavy metals to the groundwater. Of greater concern would be the large lagoons required to hold the liquid sludge prior to land application. Much of the soil in the central Iowa area is moderately to highly permeable. Thus, without liners, it would be expected that water movement to the groundwater would be significant. As a result, there would be a serious degradation in groundwater quality in the vicinity of these lagoons.

At the three representative land application sites that were visited, varying potential for groundwater contamination exists. Thus, potential impacts at the three sites are presented separately below.

Site 1 - Polk County

Land application should have a limited impact on groundwater at Site 1. Although groundwater levels are high during the spring in the well dug in the surficial aquifer, most of the site is at a higher elevation than this well. The soil is generally moderately permeable; so, except in areas or times when the water table is high, there should be only a limited contaminant transfer to the groundwater as long as proper application levels are maintained.

Site 2 - Warren County

The high water table in the lower section of the site would result in land application having a significant impact on groundwater. In the upper section, the water table is lower; and permeability is moderately slow so the impact will be minimal at proper application rates.

Site 3 - Warren County

The water table over much of the site is apparently sufficiently low for land application, and permeability is slow. Thus, land application would have a limited impact on groundwater.

Marketing of Compost (Alternative 2)

If compost were used widely as a soil amendment, some groundwater contamination could occur. Unlike land application, application rates cannot be controlled; and use in areas of high water tables or improper soil cannot be restricted. Additionally, heavy watering which will promote deep seepage into the groundwater can be anticipated in conjunction with the use of compost. However, while the potential is high, the use would be limited and dispersed so that overall impact would be minimal.

A more serious impact on groundwater can be anticipated in the area adjacent to the treatment plant that would be utilized for composting. Composting generates large volumes of leachate high in nitrogen which, if not contained, could have a significant impact on groundwater in the vicinity of the operation.

Landfilling (No-Action Alternative and Alternatives 3 and 6)

Disposal of sludge and compost in a landfill carries with it a large potential for groundwater contamination if the landfill is improperly sited or improperly managed. Water seeping through the landfill can carry contaminants to the groundwater, or high groundwater levels can leach contaminants out of the sludge.

At the Metro East Landfill (Site 4), where sludge is now being disposed of, the water table is 20 to 30 feet deep; and the sludge is covered daily along with the other waste to minimize infiltration. Groundwater wells around the site which are monitored twice each year have never indicated any substantial groundwater deterioration. Thus, the impact on groundwater from sludge disposal is minimal.

Land Reclamation (Alternatives 5 and 7)

The spoil material within the abandoned mine areas is highly porous, and rainfall and runoff can easily travel through it after the saturation moisture content is reached. Thus, under present conditions, there is a significant impact on the groundwater. It is expected that the more successful the reclamation of these areas, the less excess water will be available to leach through the spoil material to the groundwater.

At the necessary application rates and the high permeability of the reclamation areas, it is expected that some contamination will be leached from the sludge or compost; however, under existing conditions, the additional impact should be minimal in the short term. In the long term, use of sludge and compost should provide a more impervious ground cover and reduce contaminant leaching.

SURFACE WATER

General

The liquid, dewatered, and composted sewage sludges contain measurable amounts of heavy metals and organics in addition to the greater amounts of coliform bacteria and ammonia-containing compounds (NH_3, NO_3, organically bound nitrogen). All of these materials can adversely effect the quality of surface waters in the ICA if permitted to enter the surface waters by improper management. The primary mode of entry is from soil erosion either from normal rainfall or from surface runoff during application in the case of liquid sludges.

As outlined previously in the "Affected Environment" section, the area considered for sludge application is drained by a number of surface rivers and streams, namely the Middle, South, and Des Moines rivers and their tributaries. The city of Des Moines obtains its public water supply from a shallow sand and gravel surface aquifer hydraulically continuous with the Raccoon River. Consequently, none of the SMA's pose any serious threat to this municipal water supply. The relationship of surface water quality to groundwater quality is discussed elsewhere.

Soils in the sludge management area are typically well drained but subject to erosion if not properly managed. However, the Tama-Muscatine association of Polk County and the Nodaway association of Warren County are more subject to poor drainage and are of additional concern from the standpoint of surface ponding and increased runoff (EPA, 1977; NOAA, 1980).

The existing surface water quality, as previously discussed, indicates seasonal violations of the present Iowa water quality standards for coliform bacteria, dissolved oxygen, ammonia, DDE, and dieldrin (Kennedy, et al, 1980). Violations typically occur under low flow conditions. Dissolved oxygen and ammonia violations are primarily attributed to point source discharges, while the others are largely from nonpoint sources.

The possible surface water impact of the proposed sludge management alternatives is contingent upon the method of final disposal (landfill, land application, land reclamation) and the condition of the sludge (digested/dewatered, digested/liquid, composted). The condition of the sludge as it may impact surface waters is more exactly a function of its moisture content, as this is the main factor which influences the potential for erosion/runoff into surface waters. The composition of the sludges remains unchanged among the various alternatives, with the exception of moisture content; and, thus, the relative impacts of the alternatives reduce to a consideration of the relative potential for surface erosion and its entry into the surface waters at the various disposal sites.

Analysis of the present digested sludge produced by the Des Moines Wastewater Treatment Plant provides a basis for assessing the potential of surface runoff and erosion from the selected land application areas. Considering the impact of eroded soils amended with sludge to be the sum of the effects of the soil and sludge separately, the interpretation of the sludge quality data as an indicator of sludge erosion impact on the surface waters can be made. Sludge quality data are summarized in Table 19. For application at agronomic rates, a comparison of sludge and fertilizer compositions are shown in Table 20. It is apparent from Table 19 that the constituents of concern from a surface erosion standpoint are some of the heavy metals (cadmium, chromium, lead, mercury, copper, nickel, zinc), the oxygen demand, and the nitrogen series. It is clear from these data that surface erosion on sludge amended sites will cause adverse impact on surface waters. The heavy metal content of the Des Moines digested sludge is typical of sludges from industrialized municipalities. Ranges of metals in typical sludges are summarized in Table 21 for comparison.

TABLE 19

SIGNIFICANT QUALITIES OF DES MOINES WWTP DIGESTED SLUDGES[1]

Parameter	Typical Concentration	
	(mg/kg dry weight)[2]	(mg/l)[2]
Classical		
Ammonia-Nitrogen	240,000	950
Total Nitrogen	720,000	--
Total Phosphorus	260,000	--
BOD		2,130
TOC		9,400
Drinking Water Standards		
Arsenic	2.91	0.7
Barium	<20	<1
Cadmium	21.5	1.31
Chromium (total)	507	21.2
Lead	670	7.4
Mercury	6.1	0.0025
Nitrate (as N)	70.6	4.3
Selenium	22	0.45
Silver	no data	1.04
Endrin		<0.001
Lindane		no data
Methoxychlor		no data
Toxaphene		<0.0001
2,4-D		<0.0001
2,4,5-TP		no data
Other Metals		
Antimony	no data	1.7
Beryllium	no data	0.02
Copper	500	29.8
Nickel	230	13.5
Thallium	no data	0.5
Zinc	2,100	120
Priority Pollutant Organics		
Volatiles (31 compounds)		
Methylene Chloride		0.028
1,1-Dichloroethane		0.0033
1,1,1-Trichloroethane		0.008
Trichloroethylene		0.017
1,1,2-Trichloroethane		0.041
1,1,2,2-Tetrachloroethane		0.019
Chlorobenzene		0.067
Toluene		0.22
Ethylbenzene		1.86
Mineral Spirits		5.1
All Others		
Pesticides (26 compounds)		
Aldrin		0.0001
PCB-1242		0.21
All Others		<0.0001
Phenols		0.11
Cyanides	4.92	<0.01
Base Neutrals (46 compounds)		
Di-n-butyl Phthalate		0.087
1,4-Dichlorobenzene		0.17
Diethyl Phthalate		0.06
Dimethyl Phthalate		0.013
Fluoranthene		0.0018
Hexachlorobenzene		0.014
Naphthalene		1.25
Phenanthrene		0.0009
Pyrene		0.018
1,2,4-Trichlorobenzene		0.64
All Others		<0.001

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[1] Compiled from the following laboratory reports:
Twin City Testing and Engineering Laboratory, Inc., No. 2-3444, 4/15/81.
Minnesota Valley Testing Laboratories, Inc., P.O. #B00610, 3/9/81, and W.O. #SN-523, 4/9/81.
Hazelton Environmental Sciences Corporation, Rpt. #9104-083, 8/25/80.
Des Moines WWTP Data, June-November, 1979, and April, 1980.

[2] Based on Percent Solids = 6.10%

TABLE 20

RESULTS OF ANALYSES OF DES MOINES SLUDGE AND FERTILIZER SAMPLES
MAY 4, 1978

Parameter	Unit	Fertilizer	Sludge
Nitrogen	%	11.8	2.5
Phosphorus	%	1.6	1.2
Potassium	%	3.2	1.5
Calcium	%	2.6	3.8
Magnesium	%	2.35	0.73
Sodium	%	0.69	0.35
Copper	ppm	13,200	695
Zinc	ppm	6,900	2,580
Iron	ppm	2,688	2,168
Manganese	ppm	510	410
Nickel	ppm	16.5	330
Lead	ppm	345	970
Cadmium	ppm	1.5	49.5
Boron	ppm	0.8	0.8
Organic Matter	%	14	54
pH	-	5.3	8.0

TABLE 21

TYPICAL HEAVY METAL CONTENT OF MUNICIPAL SLUDGES

Metal	Range (mg/kg)	Average Concentration (mg/kg)
Cadmium	3-3,410	110
Chromium	220-570	360
Copper	470-810	650
Nickel	2-3,500	350
Lead	130-900	540
Zinc	310-3,510	2,300

SOURCES: JWPCF, October, 1980
JWPCF, October, 1979
ES&T, July, 1981
EPA 430/9-76-013, November, 1976

The priority pollutant analysis shows that only very low levels of pesticides are inherent in the sludge. The trace volatile organics with soil spreading incorporation and environmental exposure will be liberated to the atmosphere. Remaining priority pollutant organics are largely absent or at low levels.

Comparison of the information in Table 20 indicates that increases in nickel, lead, and cadmium can be expected with the use of sludge as a substitute for commercial fertilizers. However, additions to the soil of copper and zinc are decreased with the use of sludge as compared to fertilizers with application at agronomic rates.

In addition to its value as a fertilizer, sludge has significant value as a soil conditioner. The high organic matter content, which constitutes approximately 50 percent of the solid fraction of sludge, improves the physical properties of soils (Epstein, et al, 1976). Increases in soil water content and water retention have been demonstrated and may significantly reduce water stress in plants during the growing season (Epstein, et al, 1976). Further, sludge application results in increased aggregate stability, thus stabilizing soil structures since aggregates are more resistant to disintegration by water (Epstein, 1975). Consequently, improvements in soil stability with sludge application will result in slightly reduced erosion potential as discussed in the "Soils" section.

The primary impact to surface waters will be degradation of the water quality from erosion of soil containing sludge into the waterways. This will lead to increases in turbidity, BOD, some metals, and decreases in dissolved oxygen in the streams. A secondary impact will be the deposition of silts on the stream bottoms and changes in the benthic habitat. Short-term effects involve the degraded water quality from specific active erosion sites or events. However, the long-term effect will be the buildup of contaminants on the stream bottom, originating from the disposed sludge and long-term bleeding of these constituents into the stream and changes in benthic habitat. Critical in the long-term are the heavy metals because of their persistence, while the increase in BOD loading and lower oxygen content will be more acute in the short term. All options involving dewatered sludge will require a processed sludge storage area, in addition to the actual disposal site, which will be subject to runoff that may impact surface waters.

Landfill Impacts

Chapter 28 of the Iowa Solid Waste Disposal Rules provides definitive guidelines on the operation of sanitary landfill facilities. These rules require that land disposal sites and facilities not be located where there is a reasonable probability that disposal of solid waste within such an area will have a detrimental effect on any surface water. In addition, a Plan of Operation for the proposed facility must be presented to the Department for approval and must include detailed information on drainage patterns and drainage control structures which are designed to prevent surface water impacts. The design storm for these structures is not defined by the regulations but should follow good engineering practice.

Due to these requirements, soil loss from an approved landfill would be limited to that occurring as a result of initial construction of surface runoff control structures and roadways. No runoff or erosion from the active portion of the landfill site is permitted. The appropriate runoff and erosion control mechanisms to be provided are dependent on site-specific requirements. Consequently, no adverse surface water impacts are likely under the landfill alternatives.

The present Metro East Landfill is proposed for landfilling of the treated sludges for these disposal alternatives. It is located remote from major surface water drainage systems and, thus, represents an inherently low risk site with respect to surface water contamination. Combined with proper site management and runoff control, as established under Chapter 28 of the Iowa Solid Waste Rules, adverse surface water impacts can be eliminated.

The alternatives under consideration involving landfilling are Alternatives 3a/b (anaerobic digestion/dewatered sludge) and 6 (composted sludge). Landfilling of liquid sludges is not envisioned. The qualities of composted versus anaerobically digested/dewatered sludge are not significant with respect to surface water impacts. Likewise, the dewatering process of choice (belt press, centrifuge) does not effect the potential surface water impacts. Thus, Alternatives 3 and 6 are both seen as having an equally low potential of adverse impact.

Land Application Impacts

Chapter 33 of the Iowa Solid Waste Disposal Rules provides for the control of sewage sludge application directly to land and the control of surface runoff and erosion to preclude impact from these operations on surface waters. Provisions are also included for subsurface injection of liquid sludges in close proximity to surface waters to further mitigate potentially adverse impacts from surface runoff.

Alternatives 1a/b and 4 provide for ultimate sludge disposal by land application. Alternative 4 utilizes a three percent solids sludge which increases the probability for surface ponding and direct runoff during application. However, subsurface injection can be used to mitigate this potential impact.

Land application of sludge is envisioned for representative Sites 1, 2, and 3. Disposal Sites 2 and 3 are each located adjacent to surface waters. Site 2 borders the Middle River, while Site 3 bounds a tributary of the South River. Site 1, however, is located more remotely from existing surface waters and drainage patterns. The potential for impact on surface water at Sites 2 and 3 would, thus, be expected to be greater than at Site 1. Site 2 represents a worst possible case, while Site 1 is typical of the best possible site in the proposed disposal area with regard to surface waters. Proper site management in compliance with the requirements of Chapter 33 of the Iowa Solid Waste Disposal Rules, however, can effectively eliminate adverse surface water impact from each of these typical sites.

Land Reclamation Impacts

Sludge management Alternatives 5 and 7a/b provide for strip mine reclamation at sites in the Marion County area in close proximity to the Red Rock Reservoir. These alternatives involve the filling of existing mining depressions and planting of surface vegetation. The sludge will serve to amend the intermediate and final cover at the site. Surface runoff and erosion are the main considerations with these sites; and, in this regard, considerations of surface water impact are the same as for the land application alternatives because of the use of sludge as the cover material.

As with the alternatives previously discussed, surface water impact from these operations can be effectively mitigated by proper engineering, planning, and management of the surface of the site. Provisions for surface runoff collection and containment, surface contouring, and surface vegetation and stabilization can be readily incorporated into the design and the management of the overall sludge disposal plan with the elimination of adverse surface water impact.

Compost Resale Impact

Alternative 2 utilizes resale of the final sludge product. IDEQ Rules, Chapter 33, 33.1, prohibit the sale of sludge products to individuals for home garden use and for use on food crops for human consumption. Consequently, it is assumed that most compost would be applied to farmland, parkland, and/or nurseries. Impact on surface waters would be a consequence of stormwater runoff from such sites.

As compared to the other sludge management options involving land application, the application rate will presumably be less with this alternative than the agronomic rates proposed for the other alternatives. Distribution of the compost would also presumably be more dispersed than under the other alternatives. Therefore, any erosion and entry into surface waters will be somewhat mitigated by this dispersed, low-rate nature of the application. However, the potential for adverse water quality impacts is about equal to that of dewatered sludge land application because close control over the method of compost application is not feasible with this alternative.

No-Action Alternative Impacts

The present management scheme for wastewater treatment plant sludges in the Des Moines ICA involves low-rate land application, as defined by the Iowa Solid Waste Disposal Rules, of digested/dewatered sludges and landfilling at the Metro East facility. Approximately 17 percent of the present 15,150 tons generated annually are land applied by 5 facilities at 6 sites in Polk County. A total of 8 municipal facilities generate sludge in the Des Moines ICA, with an additional 2 commercial/semiprivate facilities. The landfill and present disposal sites are managed under the Iowa Solid Waste Disposal Rules, Chapters 28 and 33; and no adverse impacts have been noted. Consequently, the continuation of this system would not be expected to degrade surface water quality.

AIR QUALITY

General

Air quality impacts from the various SMA's will be primarily from internal combustion engine vehicles used to load, transport, and apply the sludge in its various forms at the disposal sites. Secondary impact from localized fugitive dust emissions and odors are likewise anticipated.

Impacts from Sludge Management Alternatives

Vehicle Emissions

All of the options under consideration involve the use of diesel-powered vehicles for handling and transport. Thus, a major determinant of impact is the net mileage associated with each option. This is, in turn, dependent primarily on the distance to the disposal site and the number of hauls required. Mileage on-site to handle and place materials will vary with the ultimate disposal method and acreage involved. On-site travel will be greater for land application than for both the landfilling and the land reclamation practices.

The sludge management study area is encompassed by the South Central Iowa Air Quality Control Region (AQCR). The Des Moines metropolitan area is a subarea of this AQCR; and the remainder of the region, except for Marshalltown, is considered as a unit. Portions of Polk County included in the Des Moines subarea are presently a nonattainment area for particulates and carbon monoxide, while the remainder of the AQCR has attained all the primary NAAQS. Typical air quality is shown in Table 22 which includes the present primary NAAQS for comparison. For the nonattainment pollutants, regulatory direction for the various alternatives would come from Iowa's SIP for nonpoint vehicular emissions. Likewise, for nonpoint sources, maintenance of the NAAQS presently attained for the areas is under the jurisdiction of the Iowa SIP.

Annual mileages are summarized by alternatives in Table 23. Disposal points for the alternatives are also noted in Table 23. Haul distances for the land application alternatives were calculated from distances to the representative sites. Mileages were based on projected liquid and dewatered sludge volumes. Diesel-powered tractor trailers of 23 cubic yard capacity are used for transferring the dewatered sludge and compost to the disposal site, but liquid sludge transfer trucks of 5,500-gallon capacity are used for SMA 4. Application at the site is performed by 13 cubic yard spreader trucks for the dewatered material or 4,000-gallon injection trucks for the liquid sludge. The much higher road mileage resulting from the combination of smaller volume trucks and an 8- to 10-

TABLE 22

AIR QUALITY HISTORICAL DATA
SOUTH CENTRAL IOWA AQCR

Sampling Location	Year of Data	Particulates ($\mu g/m^3$)[4]	Sulfur Dioxide ($\mu g/m^3$)[5]	Carbon Monoxide (ppm)[6]	Nitrogen Dioxide ($\mu g/m^3$)	Ozone ($\mu g/m^3$)
Ankeny	1980	86/197	-	-	-	-
Altoona	1980	74/225	-	-	-	-
Des Moines	1980	94/470[1]	9/81[2]	2.8/18.2[3]	43.6	70
Grimes	1980	106/320	-	-	-	-
Johnston	1977	90/409	-	-	-	-
Pleasant Hill	1980	64/191	-	-	-	-
	1978	-	-	-	16.6	-
Carlisle	1977	-	2/36	-	12.9	-
Bondurant	1980	-	-	-	-	73
Winterset	1979	-	-	-	-	76
Eldredge	1977	-	-	-	-	41
Primary NAAQS		75/260[4]	80/365[5]	9/35[6]	100	235

[1] Data from 5 Stations
[2] Data from 3 Stations
[3] Data from 2 Stations
[4] Annual geometric mean/24-hour maximum
[5] Annual arithmetic mean/24-hour maximum
[6] 8-hour maximum/1-hour maximum

TABLE 23

ROUND TRIP HAUL DISTANCES AND TOTAL MILEAGE

Alternative	Disposal Site(s)	Round Trip Haul Distance (miles)[1]	Annual Mileage (miles/year)		
			Transport	Application	Total
1a/b	Sites 1, 2, and 3	78.5[2]	328,404	50,000	378,404
2	Resale of Product	78.5	328,404	50,000	378,404
3a/b	Metro East Landfill	28.5	119,316	-	119,316
4	Sites 1, 2, and 3	85.0[2]	1,720,400	277,000	1,997,400
5	Strip Mines/Marion County	74.3	310,804	-	310,804
6	Metro East Landfill	28.5	119,316	-	119,316
7a/b	Strip Mines/Marion County	74.3	310,804	-	310,804
No-Action	Metro East Landfill; Land Application at Present Sites	24.2	101,424	-	101,424

[1] Based on weighted average distance from WWTP to various disposal sites with vehicles as stated in text.
[2] Includes disposal of sludge from existing WWTP's which will not be regionalized in new WWTP.

fold increase in sludge volume for SMA 4 should be noted. Transport of the liquid sludge from SMA 4 requires 20,240 trips per year, while the remaining alternatives require 4,182 trips per year.

Table 24 compiles the anticipated emissions for NAAQS criteria pollutants based on current EPA emission factors for heavy duty diesel-powered vehicles (EPA, 1977). These factors represent worst case emissions by considering vehicles under normal operation after an initial break-in period of one year.

Comparison of the alternatives indicates that landfilling at the Metro East Landfill involves the least transportation mileage and, thus, produces the smallest vehicular air quality impact. Alternatives 1a/b, 2, 5, and 7a/b each produce comparable, yet low, impacts. Alternative 4 produces greater emissions than the other options because of the increased volume of sludge to be disposed.

The Iowa SIP inventory for Polk County (1977 base year) shows 39,520 tons per year of particulates from nonindustrial nonpoint sources. Of this, motor vehicle-related dusts account for 36,815 tons per year. Nonpoint source emissions for carbon monoxide total 101,673 tons per year, of which motor vehicles contribute 98,500 tons per year. IDEQ has indicated that the available emissions increment for particulates in attainment areas will be 15-20 $\mu g/m^3$ for a 24-hour period (Durham, 1981). Increases in carbon monoxide emissions of the magnitude envisioned for the various alternatives are not considered significant (Durham, 1981).

The effects of these pollutants are both short-term deterioration of the air quality in the general AQCR and irritant effects. Long-term impact will be an extension of this degradation and more chronic effects on the population of the area, its flora, and its fauna.

Comparison of the anticipated annual emissions of particulates and carbon monoxide for the proposed alternatives to the emission inventory for Polk County, however, shows that the impact of the proposed operations on air quality in the Des Moines AQCR subarea will be minor. Results for these two parameters suggest that similar minor impacts can be expected for the other criteria pollutants listed in Table 24. Degradation of air quality and the incidence of the above mentioned effects in the region resulting from the sludge disposal operations are expected to be below detectable limits.

Ammonia-Nitrogen Emissions

Ammonia-nitrogen (as N) accounts for approximately 2 to 3 percent of the dry weight of the liquid sludge, of which 50 percent will be lost to the atmosphere during drying (EPA, 1978). On the basis of design sludge quantities, this amounts to approximately 38 tons per year of nitrogen-containing gases emitted. Liquid sludge loses about 1/4 as much ammonia-nitrogen and, therefore, will emit less of this material to the air. However, these emissions have caused no known air quality problems in similar operations in Los Angeles County, California (EPA, 1978). It

TABLE 24

TRANSPORTATION EMISSIONS

Alternative	Annual Mileage (miles)	Emissions (tons per year) Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides	Sulfur Oxides
1a/b	378,404	0.55	12.0	1.9	8.7	1.2
2	378,404	0.55	12.0	1.9	8.7	1.2
3a/b	119,316	0.17	3.8	0.6	2.7	0.37
4	1,997,400	2.9	63	10.1	46	6.2
5	310,804	0.45	9.8	1.6	7.2	0.99
6	119,316	0.17	3.8	0.6	2.7	0.37
7a/b	310,804	0.45	9.8	1.6	7.2	0.99
No-Action	101,424	0.15	3.2	0.51	2.3	0.31

is doubtful that this loss in ammonia-nitrogen will have a significant effect on air quality.

Odors

"Odor" is defined as a sensation which results from stimulation of the olfactory organs; whereas, "an odor" is the experience of perceiving a smell. The property of a substance or mixture of substances that effects or stimulates the sense of smell is called an "odorant." Odorous compounds generated by the various project alternatives may have pleasant or unpleasant odors, and an odor which is offensive to one person may be acceptable to another person. While the quality of the odor will be highly subjective, most people are usually aware of odors and will generally agree that some odorous compounds are obnoxious. Many such odors can be detected when the odorant is present in a very low concentration. This concentration is known as the odor threshold concentration which is defined as the minimum concentration that will arouse stimulation of the olfactory nerves. A recognition threshold concentration for odor is defined as the minimum concentration at which the odor quality can be recognized.

The degree of obnoxiousness of malodorous gases will depend not only on the concentration of the odor and on the person exposed to the odor but also on the intensity of the odor. Most people will be particularly sensitive to unfamiliar odors; however, olfactory sensitivity varies from person to person. The olfactory senses of persons continually exposed to an odor become insensitive to that odor with time; therefore, odor nuisance determinations are highly subjective.

Numerous subjective and objective odor evaluations of sewage sludges have been conducted. One such study conducted with liquid sludge by Colorado State University used a panel of faculty members and wastewater treatment plant operators (EPA, 1978). The odor tests were taken within a few meters of digested sludge drying beds. Over a period of six to twelve months, the panel was asked to describe the odor level in terms of the following numerical rating system:

- 0 - undetectable
- 1 - faintly detectable
- 2 - detectable
- 3 - objectionable
- 4 - very objectionable

The basins took from six to twelve days to reach the No. 1 level. The panelists noted that the odors did not carry very far beyond the basins.

The results of the tests were confirmed by field trips to drying basins in Sioux Falls, South Dakota; Topeka and Wichita, Kansas; and Tulsa and Oklahoma City, Oklahoma. None of those facilities were found to have serious, continuing odor problems. However, odors were a problem where inadequate digestion occurred due to failure of the sludge treatment system.

Aging of dewatered sludge during stockpiling will liberate odorous compounds, as will the application of fresh liquid digested sludge applied directly to the land. The odorous emissions decrease during the drying, aging process on exposure to the environment. Thus, the intensity of odors from both types of sludges are expected to be similar, but the most significant emissions will be during stockpiling for the dewatered sludges and at the site for the liquid sludge storage and disposal. Subsurface injection of liquid sludges will greatly reduce odorous emissions during disposal operations (Herceg, 1980).

Composting after mechanical dewatering would be expected to produce more intense odors than the stockpiled dewatered and anaerobically digested sludges judging from the amounts of methane and other gases which are collected during the digestion process. Thus, composting areas are considered the most critical from an odor producing standpoint.

Stabilized and dry sludge products have minimal odor potential. However, sludge does have the potential for odor nuisances if disposal and storage operations are not properly managed. Odor problems can be kept to a minimum with proper digester operation, sludge handling techniques, and land management at the disposal site.

Odors can be a serious problem at a sludge landfill unless preventative measures are taken. The sludge should be covered as frequently as necessary to minimize odor problems. Lime or chemical masking agents can be applied to reduce odor problems.

The proposed sludge management area, with the exception of the wastewater treatment plant site itself, is rural. A characteristic of the odors generated during the sludge handling is that they are familiar rural odors and are taken as part of the agricultural way of life. For all the management alternatives, proper site management practices are available to mitigate any major adverse impact these odors may have on the surrounding population. On this basis, odorous impacts are considered a minor consequence to any of the options.

Fugitive Dusts and Airborne Pathogens

Fugitive dusts will result from transportation operations on rural roadways and from the transfer and handling of the dried sludges. In this regard, use of liquid sludges will not present any potential for this latter emission.

Roadway dust will be limited to unpaved rural roadways in the immediate vicinity of the right-of-way. Travel from the wastewater treatment plant to the Metro East Landfill will be entirely on paved surfaces as will transfer to Site 1 and the land reclamation sites in Marion County.

Transfer to Sites 2 and 3 will involve traffic on unpaved surfaces of six to ten miles of a total round trip of approximately eighty miles (Table 23). On-site travel at each disposal site for all the options under consideration will generate dust. Due to the limited travel on unpaved surfaces, the localized nature of the dust, and its short travel distance, impact from these operations is anticipated to be minimal. Mitigative measures can include route selection and surface maintenance with oil, water, or calcium chloride for dust control should further control of adverse impacts be desired.

Of greater concern is the potential for airborne bacteria in the vicinity of the stockpiling and disposal operations. Use of uncovered trucks for transfer of the dried sludges should be considered as a source of airborne bacteria.

A large body of information concerning airborne organisms in the vicinity of sludge handling operations has been developed. Because the sludge particles will have been thoroughly dried before becoming airborne, little odorous, volatile material will be present; and pathogenic organisms will have been largely desiccated. However, spores and certain parasite eggs can survive in dry conditions for relatively long periods. This is discussed in more detail under the "Public Health" section.

Normal winds will not spread significant amounts of dried sludge, though the strong (over 11 mps or 24 mph) winds which occasionally occur (during about 2 percent of the year) will spread the dried material according to the local wind rose and prevailing winds. It is difficult to estimate the amount of material blown during such winds.

The present literature indicates that these operations should not be considered a community health problem, even in urbanized areas; but precautions to protect the health of sludge handling personnel should be instituted. These should include medical screening and respiratory protection (Cookson, 1981). For the Des Moines ICA, a low, rural population density exists in the service area with the exception of the wastewater treatment plant site and incorporated areas through which truck transport will be necessary. Use of covered transfer vehicles can effectively eliminate fugitive sludge dusts resulting from transit. Location of the sludge stockpiling/storage area at the wastewater treatment plant site in the industrial district will avoid close proximity to hospitals, schools, and other densely populated areas of the Des Moines ICA which will minimize dust impacts. Site operations, which include covering of stored materials, can further mitigate these impacts. Consequently, adverse impacts from fugitive dusts on the local population are not anticipated.

NOISE

General

Noise may interfere with a broad range of human activities and degrade public health. It may interfere with both listening situations, which can be directly quantified in terms of noise level, and nonlistening situations (concentration, relaxation, sleep), which are dependent on factors other than the physical characteristics of the noise.

The EPA has established guidelines which are considered to be the maximum exposure levels to avoid significant adverse impacts. Specifically, equivalent 24-hour sound levels [L_{eq} (24)] of 70 decibels (db) or less for intermittent noise are considered necessary for protection from hearing loss. Additionally, day-night outdoor noise levels (L_{dn}) of 55 db and indoor L_{dn} of 40 db or less are considered necessary for protection from sleep interference as it relates to public health (EPA, 1976).

Noise Sources and Effects

Noise generation related to the solids management alternatives will be associated with sludge processing at the treatment plant site, sludge transport, and application or disposal operations. The plant site, situated in an industrial area, will experience noise associated with the use of centrifuges, belt filter presses, compressors, and equipment for solids handling. High noise levels are associated with all of the above. The impact these noise producers will have is minimal due to the industrial character of the area and the fact that sludge processing noise presently affects the vicinity.

The potential areas considered for sludge application are rural in character, with the majority of the land under cultivation and planted in either soybean or corn. Some pasturelands are also present. Dwelling units are scattered along highways and section line roads, seldom exceeding a density of more than ten dwellings per square mile. The landfill site and mine reclamation sites are also located in sparsely populated rural settings. Noise generated by liquid dewatered sludge or compost application (injection or spreading) equipment is expected to be similar to that produced by other farm equipment, such as tractors, trucks, and manure spreaders. Therefore, no particular noise impact is anticipated with this phase of operation. Some reduction in noise may be expected to the extent that sludge application replaces fertilizer and/or manure application on these operations. Similarly, disposal operations associated with landfilling or land reclamation operations are not expected to have any major impact. Sludge disposal at the landfill presently occurs, and the additional sludge quantities will have little effect on noise generations. The remote location of the strip mine sites will serve to attenuate noise levels from reclamation activities to roughly that of ambient conditions experienced by area noise receptors.

The most significant noise impacts of the proposed alternatives are associated with the transport of solids to remote storage and final disposal sites. Of primary concern are the portions of routes going through residential areas. Noise impacts created by transport vehicles are considered negligible in commercial/industrial zones and on highways. Effects of vehicle noise on people in residential areas can be estimated based upon two major parameters. The first parameter is the frequency of the number of trips per day, while the second parameter deals with the distances through the residential areas involved with each selected route.

This evaluation procedure assumes that vehicles used for each alternative have the same noise level and pass through residential areas at the same speed. Table 25 summarizes the transport frequency for the various alternatives. A direct relationship exists between the sludge volume produced and number of truckloads transported per day.

Perusal of the table reveals that Alternative 4 is ranked the highest in terms of undesirable noise frequency, while Alternatives 3 and 6 and the No-Action Alternative are considered the lowest. This ranking would change somewhat if impacts were solely based on the total mileage and subsequent total quantity of noise generated. However, since residential disturbances constitute the primary negative impact of concern, the present procedure is established.

Noise generation with all sludge management alternatives are long-term, unavoidable consequences of the project. Mitigative measures include selecting transport routes which minimize travel through residential areas and maintaining equipment and mufflers in top working order. The level or duration of noise expected will not be sufficient to cause long-term or irreversible impacts such as hearing impairment or loss to casual receivers. Compliance with OSHA regulations will adequately safeguard plant personnel and equipment operators from experiencing any adverse affects of high noise levels. In summary, considering the locations of noise generators, the affected areas, and the frequency of receiver exposure, the noise contribution of the project will be minimal.

ENERGY UTILIZATION AND PRODUCTION

Energy requirements for each alternative have been summarized in Table 26. This summary presents the energy utilization and production for both the in-plant processing of sludge and the subsequent transport and ultimate disposal of the sludge. In addition, the estimated energy value of the sludge nutrients is also included.

Sludge Processing

The energy requirements for sludge processing consist of the primary energy requirements for processing the sludge and the energy value of the process by-products. Energy requirements were determined based on design parameters presented in the 201 Facility Plan and energy requirement data from EPA (EPA, 1978). Of the two sludge processing options, composting and anaerobic digestion, composting had the lower energy requirement. However, while the composting process requires less energy, it produces no usable energy by-product. Anaerobic digestion produces methane whose energy value is roughly equal to 3-1/2 times the total energy requirement of the process. While the No-Action Alternative also uses anaerobic digestion, the methane produced is vented to the atmosphere and not used; and, thus, net energy production is zero.

Sludge Transport

Energy requirements for the transport and disposal of the processed sludge primarily consist of the fuel that is consumed hauling the sludge

TABLE 25

ANNUAL RESIDENTIAL MILEAGE AND NOISE RANKINGS

Alternative Number	Sludge Disposal Alternative	Disposal and/or Storage Site	Round Trip Haul Distance (miles)	Round Trip Residential Distance (miles)	Number of Round Trips Per Year	Annual Residential Mileage	Ranking of Alternatives
1a/b[1]	Dewatered sludge/land application	Farm Site 1 Farm Site 2 Farm Site 3	11.6 34.8 58.8	0 0 3	1,255 1,672 1,255	0 0 3,765	2
2	Dewatered sludge/composting/storage/marketing	Farm Site 1 Farm Site 2 Farm Site 3	—	—	—	3,765	2
3a/b	Dewatered sludge/landfill	Metro East Landfill	25.6	0	4,182	0	1
4[1]	Liquid sludge/land application	Farm Site 1 Farm Site 2 Farm Site 3	11.6 34.8 58.8	0 0 3	6,072 8,096 6,072	0 0 18,216	3
5	Dewatered sludge/composting/reclamation	Strip mines, Marion County	86.0	1.4	4,182	5,855	2
6	Dewatered sludge/composting/landfill	Metro East Landfill	25.6	0	4,182	0	1
7a/b	Dewatered sludge/reclamation	Strip mines, Marion County	86.0	1.4	4,182	5,855	2
No-Action	Dewatered sludge/land application	Metro East Landfill, various sites	25.6	0	4,182	0	1

[1] Weighted average based on distance and proportional acreage

TABLE 26

SUMMARY OF ENERGY UTILIZATION AND PRODUCTION

	Energy (Btu x 10^9)				
	Sludge Processing				
Alternative	Utilization	Production	Sludge Transport and Disposal	Fertilizer Energy Value	Net Energy Requirement
No-Action Alternative Anaerobic digestion Sludge dewatering Truck transport Landfill	16.3	0	5.1	0	21.4
Alternative 1 Anaerobic digestion Sludge dewatering Truck transport Land application	36.5	(131)	8.0	(5.4)	(91.9)
Alternative 2 Sludge dewatering Composting Truck transport Market as fertilizer	25.7	0	8.0	(5.4)	28.3
Alternative 3 Anaerobic digestion Sludge dewatering Truck transport Landfill	36.5	(131)	5.1	0	(89.4)
Alternative 4 Anaerobic digestion Truck transport Land application	31.7	(131)	65	(5.4)	(39.7)
Alternative 5 Sludge dewatering Composting Truck transport Land reclamation	25.7	0	14.0	(5.4)	34.3
Alternative 6 Sludge dewatering Composting Truck transport Landfill	25.7	0	5.1	0	30.8
Alternative 7 Anaerobic digestion Sludge dewatering Truck transport Land reclamation	36.5	(131)	11.6	(5.4)	(88.3)

to the disposal site. Fuel consumed in applying the sludge amounts to less than ten percent of the total energy requirement for transport and disposal.

Comparing the disposal alternatives, the energy requirements are determined primarily by the amount of material that must be disposed of and, secondarily, by haul distance. Thus, land application of liquid sludge requires 65 x 10^9 Btu/year, while land application of dewatered sludge requires only 8 x 10^9 Btu/year. The effect of the differences in distance to the proposed disposal sites is much less pronounced. While hauling sludge to the landfill has the least energy requirement (5.1 x 10^9 Btu/year), the hauling of the sludge to the reclamation sites in Marion County increases the energy requirement to only 11.6 x 10^9 Btu/year.

Energy Value of Sludge Nutrients

An energy parameter of significance is the amount of energy required to produce and ship fertilizer to the area. For production of the three macronutrients essential for fertilizers (nitrogen, phosphorus, and potassium), costs to the consumers that are due to energy costs are estimated to be 50, 25, and 30 percent, respectively (ES, 1978). Assuming that the nutrient elements are available in proportions of two nitrogen, one phosphorus, and no potassium in Des Moines sludge, the weighted average energy equivalent of the nutrient value of the sludge becomes 40 percent.

By recycling the nutrients in the sludge, a savings will be realized equivalent to the energy requirements for the mining, manufacture, and transport of commercial fertilizer which otherwise would have been required. Basing the energy value on only the nitrogen content of the sludge which constitutes 0.3 percent of the dry matter of the Des Moines sludge, an energy equivalent of 5.4 x 10^9 Btu/year was estimated for the Des Moines sludge. Thus, energy savings would be provided by all alternatives except landfilling.

Net Energy Requirements

Net energy requirements based on energy utilization and energy production for each alternative are also proved in Table 26. As a result of the energy value of the methane produced by anaerobic digestion, all alternatives utilizing anaerobic digestion have a large net energy surplus, while the compost alternatives and the No-Action Alternative have net energy requirements. For the anaerobic digestion alternatives, those alternatives disposing of dewatered sludge have a much greater energy surplus (approximately 90 x 10^9 Btu/year) than the disposal of liquid sludge as a result of the much lower transport energy requirements.

ENVIRONMENTALLY SENSITIVE AREAS

Sources of Potable Water

The most critical impact of the various sludge management options on the potable water supply involves the Lower Raccoon River drainage basin and its confluence with the Des Moines River. The surficial aquifers used to supply drinking water to the population of the Des Moines ICA are very vulnerable to contamination by the surface waters of the Lower Raccoon River. Potential contaminants which could enter the Lower Raccoon River as outlined in the discussion of surface water impacts are nitrates, heavy metals, and fecal coliform bacteria. The latter, however, do not represent a potential impact due to the highly effective absorbtive capabilities of the overlying alluvial deposits.

None of the three representative sites are located in the Lower Raccoon drainage basin. Site 1 drains to the North River, and the other farms are drained by the Middle River (Site 2) and the Squaw Creek/South River basins (Site 3). The proposed Polk County and Warren County land application areas likewise do not incorporate the Raccoon drainage basin. Thus, the risk of contamination of the potable water supply is greatly reduced. With careful site selection of land application areas remote from the Raccoon River basin, any impact on the primary Des Moines ICA water supply will be eliminated.

The sludge management options will also directly impact private water supply wells at the disposal sites. The water quality of these wells is jeopardized by both potential surface water entry and groundwater contamination resulting from the sludge disposal activities. The utilization of the Metro East Landfill and Marion County land reclamation sites greatly reduces this impact as no drinking water wells are located at these sites. Of the remaining three representative sites, Sites 1 and 2 have shallow wells which are used for drinking water. Site 1 uses a 35- to 50-foot well for its water supply which has a water depth of 15 to 20 feet and a concrete top seal. Site 2 has two wells, one 45 feet and the other 25 to 30 feet.

Surface water entry can be excluded with proper well construction and well head completion. The local county and state health departments have detailed guidance on private well design. However, potential groundwater contamination is a more serious problem because these wells utilize the first available groundwater bearing strata which are typically unconfirmed alluvial aquifers. There is no protection of these waters from percolation of contaminants through the upper unsaturated soil zone except the natural filtration and ion exchange capacities of the overlying soils.

The direction of groundwater movement is a critical factor in assessing the potential impact on the existing wells. Groundwater movement can normally be assumed to move perpendicularly towards the nearest surface drainage pattern. Groundwater movement at Site 1 would be away from the existing well toward the drainage ditch to the north. At Site 2, groundwater would move to the south toward the Middle River, also away from the existing wells. Groundwater movement at Site 3 would be toward Squaw Creek. Any contamination of groundwater which might occur would not effect these wells provided that the sludge application was made down gradient from the wells, i.e., between the wells and the surface drainage. Contaminants would be carried away from the wells in this case. Thus, proper selection of application areas with respect to existing wells, surface drainage, and groundwater movement patterns effectively protects these shallow water supplies in close proximity to the application area.

Long-term pollution of local shallow aquifers other than those associated with the Raccoon River is of additional concern and another impact of the proposed sludge management options. Several small municipalities in the area rely on groundwater from shallow aquifers for their drinking water supply, including Mitchellville, Carlisle, and Bondurant. Both Mitchellville and Bondurant are located up gradient, i.e., upstream, of the groundwater movement; and, thus, impact from groundwater contamination is eliminated for these municipalities. Carlisle is located down gradient from a small section of the Warren County area. The remoteness of the three representative disposal sites and absence of populated areas down gradient of these sites minimizes the impact of any potential groundwater contamination on the local potable well water supplies. In addition, at each of the representative sites, groundwater is intercepted by surface waters close to the site and does not influence groundwaters over a large area. Careful selection of disposal sites in the proposed land application areas of Polk, Marion, and Warren counties with respect to the locations of off-site private and municipal wells will likewise minimize this impact throughout the entire sludge management area.

In addition to the selection of sites with consideration for localized groundwater use, the impact of the sludge disposal options on groundwater contamination can be mitigated by proper management at the application site. By selecting application rates which do not exceed the assimilative capacity of the soil, movement of metals and nitrates into the groundwater can be effectively eliminated.

Based on these considerations and with proper site disposal management and selection, adverse impact on the potable water supplies in the sludge management area by any of the alternatives will be mitigated. Selection of sites down gradient from populated areas, application rates based on crop nutrient demand, application of sludge down gradient of existing wells on the site, utilization of leachate collection systems at the landfill site, and proper well head construction combine to reduce adverse impacts on potable water supplies to acceptable levels.

Groundwater Recharge Zones

The considerations for the environmental impact of the sludge management options on groundwater recharge zones have been previously discussed as part of the impact on potable water supplies in the area. The representative disposal sites pose little potential for adversely impacting these areas.

Floodplains, Flood Retention Areas, Steeply Sloping Lands

The application of sludges to lands lying in floodplains or having steep slopes greatly increases the possibility that contaminants inherent in the sludges will enter and degrade surface waters and eventually find their way into the groundwater and potable water supplies in the area. The impact can be easily mitigated by avoiding the use of sludge on lands having slopes exceeding 14 percent. Sludges applied in floodplains should be immediately incorporated with the soil.

Applying sludges in floodplains will have no effect on flooding levels either upstream or downstream of the site because no structures or earth changes are involved. Similarly, no effect on flood retention will be realized.

Wetlands

Only two wetland areas were delineated in the proposed sludge management area by Iowa Conservation Commission biologists in 1980. These are located at the upstream edge of the Red Rock Reservoir in Polk County and consist of 50 acres of open inland freshwater and an adjacent 300 acres of shallow inland freshwater marsh (Nash, 1981). Both areas are state managed. No areas were listed for Warren County (Nash, 1981). Other seasonal wetlands could exist in the floodplains of the major surface streams in the area. As presented in the discussions concerning floodplains and surface water impacts, the potential adverse impact resulting from surface water contamination with nitrates, phosphates, and heavy metal species is readily mitigated by proper disposal, site choice, and land application techniques to prevent soil erosion and surface runoff. Disposal sites will not be located in close proximity to floodplains or known wetland areas, and sites in the vicinity of sensitive areas will be managed to eliminate surface water contamination. The state-managed wetlands are not included in the proposed Polk County land application area.

SOCIOECONOMIC FACTORS

DEMOGRAPHY

None of the project alternatives will have a significant impact on the population growth rate in the Des Moines ICA or the surrounding counties. It seems likely that, with Alternatives 1, 2, and 4 (land application of sludges or compost), the continuation of agricultural activity and low density population outside of the ICA would be encouraged. This impact on population distribution is predicated on two factors: 1) these alternatives would provide a convenient source of fertilizer/soil conditioner to the benefit of farmers; and 2) residential development in the immediate vicinity of temporary storage sites and land application sites may be inhibited.

With Alternatives 3 and 6 (landfilling dewatered sludge or compost), population impacts would be minimal. The existing Metro East Landfill would be utilized for solids disposal. Because the vast majority of sewage sludges generated in the ICA are currently disposed there, no major effects on population growth rates or distribution patterns would seem likely. Residential development in the vicinity of the Metro East Landfill would continue to be inhibited.

Under the land reclamation alternatives (Alternatives 5 and 7), additional acreage in Marion County would be made suitable for residential or agricultural uses. However, since there is no apparent lack of acreage in this county for either of these purposes, impacts to population growth rates and distribution would be minimal.

The No-Action Alternative could potentially have the greatest degree of impact among the considered alternatives. Without improvements to and expansion of existing sewage solids management facilities, the entire plan for regionalization of wastewater collection and treatment proposed in the 201 Plan would be in jeopardy. Consequently, residential development within the ICA may be constrained; forecasted population growth rates may not be realized; and residential sprawl away from the ICA may be encouraged by the need to locate new developments in areas suitable for onsite wastewater treatment systems.

LAND USE AND LAND USE PLANS

Land uses within the immediate boundaries of the proposed regional wastewater treatment plant will include space for anaerobic digesters and sludge dewatering equipment (either belt filter presses or centrifuges or compost processing). Long-term land use changes associated with the location of the regional wastewater treatment plant will primarily be the conversion of vacant land to wastewater and sludge processing uses. These changes will be compatible with surrounding land use activities (industrial uses) and will not conflict with relevant land use plans or zoning ordinances.

Short-term disruptions of land uses in the vicinity of the proposed treatment plant are likely to be associated with plant construction activities. Such disruptions, however, are not anticipated to exceed tolerable limits. These impacts are common to all of the considered "build" alternatives.

Local Zoning/Special Use Permits

Any new land uses associated with the considered sludge management alternatives, such as remote temporary storage landfill disposal and/or composting sites, would have to be consistent with and meet the requirements set forth in the respective county zoning ordinances. Specifically, land use changes in Polk County must conform to the provisions in the "Zoning Ordinance for the Unincorporated Territory of Polk County, Iowa" (revised June 26, 1975), while land use changes in Warren County would be required to conform to the provisions of the "Warren County, Iowa, Zoning Ordinance" (adopted February 19, 1980). The "Warren County Zoning Ordinance" (September 27, 1971) governs land uses in that county.

Temporary sludge or compost storage facilities, landfills, and mine reclamation projects are treated as special uses by the counties involved. As such, application for these uses must be made to the respective county zoning administrator who in turn advises his Board of Adjustment which ultimately grants or rejects the proposed use. Applications for special uses must be accompanied by a site plan, a description of the proposed use, method of operation, and other pertinent site data. Before any special use can be granted, notice of hearing by the Board of Adjustment must be provided to nearby property owners. Consequently, adverse public reaction could restrict or eliminate the possiblity of locating necessary storage or disposal facilities including land reclamation sites.

Land Requirements

Land requirements for each alternative are summarized in Table 27. For each alternative, the additional area required for sludge processing, the additional area required for sludge storage at the plant, the remote storage in the disposal area, and the land area that will be utilized for disposal are provided.

In determining the additional area for sludge processing, it was assumed that existing facility space would be used where possible. Thus, all dewatering and thickening would use existing space; and the existing digesters would be supplemented by new digesters that would be placed adjacent to the existing digesters. As a result, it is projected that no additional space would be required for those alternatives utilizing anaerobic digestion. Additional space (ten acres) would have to be provided for the compost alternatives; however, the necessary area could be provided in the area where the sludge drying beds are now located.

Plant storage has been provided where regular removal of the sludge could not be provided (i.e., for all alternatives except landfilling). For the dewatered sludge land application or land reclamation alternatives, the necessary area could be provided by the existing sludge drying beds. For the compost alternatives, the necessary space (five acres) could be

TABLE 27

SUMMARY OF LAND REQUIREMENTS

	Area Requirement			
Alternative	Sludge Processing	Plant Storage	Remote Storage	Disposal Area
Alternative 1 Anaerobic digestion Sludge dewatering Truck transport Land application	No additional area required	No additional area required	3 acres	4,100 acres
Alternative 2 Sludge dewatering Composting Truck transport Market as fertilizer	10 acres	5 acres	0	0
Alternative 3 Anaerobic digestion Sludge dewatering Truck transport Landfill	No additional area required	No additional area required	0	0 (existing landfill)
Alternative 4 Anaerobic digestion Truck transport Land application	No additional land required	0	80 acres (30 mil gal capacity)	4,100 acres
Alternative 5 Sludge dewatering Composting Truck transport Land reclamation	10 acres	5 acres	4 acres	660 acres
Alternative 6 Sludge dewatering Composting Truck transport Landfill	10 acres	5 acres	0	0 (existing landfill)
Alternative 7 Anaerobic digestion Sludge dewatering Truck transport Land reclamation	No additional land required	No additional land required	4 acres	660 acres

provided in the additional area allocated for composting. While an estimated thirty million gallons of storage capacity is projected for liquid sludge land application, provision of the necessary space on-site is not considered possible. Thus, all storage would be off-site.

Remote storage is provided when direct disposal is not practical. Where used, these storage areas would have to be constructed so that runoff and leachate are contained. For land application, a total of three acres are projected which would probably be divided into two to three small storage areas. For land reclamation, four acres are projected based on the further distance and need to coordinate site grading and compost or sludge application. For off-site liquid sludge storage, remote sludge lagoons would have to be provided to accommodate thirty million gallons of sludge. Total area requirement would be eighty acres.

Disposal area requirements are based on expected daily sludge disposal and projected sludge application rates. Land application is based on annual application of four dry tons per acre, and land reclamation is based on fifty dry tons per acre. As landfilling will use the existing landfill, no additional area is required.

No-Action Alternative

The No-Action Alternative would be associated with minimal direct effects on existing land uses. No additional land would be required for the wastewater treatment plant expansion; a modicum of land would continue to be utilized for low-rate application of sewage sludges; and the majority of sewage sludge would continue to be disposed in the Metro East Landfill. Development will most likely continue to be restricted in the vicinity of the landfill which is consistent with local land use plans and Polk County zoning which seeks to perpetuate agricultural uses in this area.

Selection of the No-Action Alternative could potentially have an adverse secondary effect on future land use and land use plans. Without improvement and expansion of existing solids handling facilities, the entire wastewater treatment system improvements proposed in the 201 Study would be in jeopardy. Consequently, needed additional wastewater treatment capacity would not be provided; and pressure for residential development in areas planned for agricultural use may increase.

Land Application of Sludge (Alternatives 1 and 4)

A limited amount of vacant or agricultural land would be necessary to accommodate the temporary storage of sludge. This change will be compatible with surrounding land uses since storage sites will be located in rural areas and will provide fertilizers/soil conditioners for agricultural use. A potential minor impact of benefit would result from reduction of residential development pressure in the vicinity of the storage sites. It is unlikely that sludge storage facilities or the application of sludges to cropland will provide any stimulus for major land use changes in the surrounding area, particularly with respect to Sites 1, 2, and 3.

The land required for storage purposes is viewed as a long-term (minimum of five years) commitment of land but not necessarily an irreversible or irretrievable commitment of land resources. Storage facilities could be removed when no longer needed, with the land returned to agricultural production.

Compost for Resale (Alternative 2)

Land use impacts will be similar to those stated for Alternatives 1 and 4, assuming compost would primarily be utilized on farmland. Use of compost on parkland or other areas would have no effect on land use.

The additional fifteen-acre requirement for composting facilities at the regional treatment plant would have a negligible impact on land uses in the vicinity of the treatment plant. This determination stems from the fact that the necessary acreage is contained within the existing and proposed plant expansion site and that the surrounding area is industrially zoned and currently affected by the existing Des Moines Main Plant.

Landfilling (Alternatives 3 and 6)

The landfilling alternatives would not require storage facilities other than those proposed for temporary or back-up purposes at the Des Moines Regional Wastewater Treatment Plant. Consequently, no impacts associated with remote storage facilities would occur.

Whether one of the landfilling alternatives is implemented or not, general uses of the Metro East Sanitary Landfill will be unchanged since this site will remain a disposal site for the Des Moines urban area. Further, landfilling of solid wastes is anticipated to be the method of refuse disposal in the foreseeable future. Assuming this is the case and that sewage sludge or compost can continue to be codisposed with refuse, no distinction can be made between land use impacts associated with landfilling only refuse or landfilling refuse and sewage solids.

The only notable difference between Alternatives 3 and 6 is that fifteen additional acres would be required at the treatment plant for compost production and processing under Alternative 6. Statements regarding this impact are presented under Alternative 2.

Land Reclamation (Alternatives 5 and 7)

Land use effects in the vicinity of the treatment plant would be identical to those previously described with the major differences between these alternatives being the additional acreage requirement for compost production.

Land use impacts in the vicinity of the reclamation sites would stem from heavy equipment and reclamation operations and the emergence of productive land from areas with little or no economic value.

The operation of heavy equipment, including bulldozers, graders, transport trucks, etc., will generate noise and dust which could be an irritant to adjacent property owners and land uses. Considering the relative isolation of many of the strip mine sites, however, these impacts would be of a short-term nature (not exceeding two years) at any given reclamation site.

A potential secondary adverse effect of reclamation operations may occur with the accidental release of acid mine waters into natural waterways or onto productive farmland. These releases could seriously impair or destroy the productivity of waterways and farmland. To minimize the potential for this occurrence, three-foot berms surrounding the reclamation sites are proposed in the 201 report. Further, all earthwork would be sloped toward the center of the site so that surface runoff would be directed to a retention pond in the center of the area. Other mitigative measures may be employed as specific site conditions warrant.

The beneficial effects include the long-term reclamation of unusable land for productive purposes, primarily cropland and woodland. Since the abandoned mine sites are located in agriculturally zoned areas, these uses will be compatible with surrounding uses. It is unlikely that land reclamation activities will provide any stimulus for major land use changes in surrounding areas.

Comparison of Land Use Impacts

Very little distinction can be made between possible impacts among the considered alternatives. The land reclamation alternatives seemingly produce the most beneficial impacts through the conversion of orphan strip mines to productive agricultural lands. The land application alternatives and the composting/fertilizer marketing alternative, while encouraging continuation of agricultural activities within the study area by providing a convenient and economical source of fertilizer, do require land use conversions for storage facilities. The liquid sludge storage capacity needs tend to rank this alternative the worst among those considered. The landfilling alternatives would have direct land use implications most closely associated with those of the No-Action Alternative. Any one of the considered alternatives could be implemented without conflict with local zoning, land use plans, and surrounding land uses. However, local special use permits would be required for all, with the exception of the No-Action and the two landfilling alternatives since a special use permit has previously been granted for the operation of the Metro East Sanitary Landfill.

Land Tenure

Depending upon the alternative chosen and implemented, there will be varying effects on land associated with sludge processing, storage, and disposal facilities. In terms of the Des Moines Regional Plant, there will be no impact on land tenure under any alternative since the city owns sufficient property for plant expansion.

Under Alternative 1, dewatered sludge land application, no transfer of ownership is anticipated. It is expected that sludge storage facilities will be located on private property, presumably that of the farmers participating in the land application program. The land utilized for sludge application will also remain in private ownership. No changes in land ownership are necessary under Alternative 2.

Under the landfilling alternatives, Alternatives 3 and 6, the Metro East Sanitary Landfill and any future landfill site will remain in the ownership of the Des Moines Metro Solid Waste Agency. Consequently, these alternatives would have no impact regarding land tenure. Alternative 4, liquid sludge land application, will presumably involve transferring from private to public ownership land necessary for liquid sludge storage. It is estimated that approximately eighty acres will be required for storage purposes. Considering this amount of land, it is unreasonable to expect that farmers would be willing to provide the necessary land. No other impacts on land tenure will be incurred under Alternative 4.

Under the land reclamation alternatives, Alternatives 5 and 7, ownership of the strip mines would be transferred to the Des Moines ICA agency. Considering the amount of sludge generated and the method utilized for reclamation, approximately 660 acres would be transferred to public ownership annually. Upon completion of a reclamation site, the ICA agency would presumably seek to transfer ownership to a private party or other public entity. No other impacts on land tenure will be incurred under the land reclamation alternatives.

ECONOMIC FACTORS

Employment

Short- and long-term employment increases are beneficial impacts common to all "build" alternatives. Short-term employment opportunities will stem from the construction of solids management facilities, while long-term employment will be associated with the day-to-day solids handling operations.

Long-Term Employment

Presently, the staff at the Des Moines Main Plant numbers over 80 employees. Projected future staffing would total approximately 86 (Donahue/Metcalf and Eddy, September, 1981). Staffing breakdowns for the existing plant and proposed facilities are provided in the 201 report. Because existing personnel classifications do not directly correspond with projected staff classifications, it is difficult to determine the exact number of employees currently utilized for solids management operations. For purposes of comparison to the No-Action Alternative, it is estimated that 12 full-time employees currently perform tasks related to solids management. Estimates for solids management personnel by job classification for all alternatives are presented in Table 28.

A review of Table 28 indicates that solids management personnel requirements will increase regardless of the alternative chosen; however, since the overall treatment plant staff is expected to increase only by about six employees, it is assumed that some current employees will receive

TABLE 28

EMPLOYMENT ESTIMATES PER ALTERNATIVE BY JOB CLASSIFICATION

Job Classification	No-Action Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Administration								
Training/Safety Officer	-	1	1	1	1	1	1	1
Land Application Coordinator	-	1	1	-	1	1	-	1
Laboratory								
Land Application Program Lab Technician	-	1	1	-	1	1	-	1
Plant Operations								
Solids Handling Facilities Operators	8 (Estimate)	9	9	9	9	9	9	9
Land Application Program/ Solids Disposal								
Soil Scientist	-	1^{1}	1^{1}		1^{1}	1^{1}		1^{1}
Transport Vehicle Operator	4	4	4	4	20	4	4	4
Application Vehicle Operator	-	4^{2}	4^{2}	-	20^{3}	-	-	-
Equipment Operator	-	3	3	-		7	-	7
TOTAL	12	24	24	14	53	24	14	24

[1] Part-Time
[2] Would assist with plant maintenance during portion of year
[3] 16 part-time (approximately 3-4 months/years) 4 full-time would also assist with plant maintenance

job classification changes.

Table 28 also indicates that Alternative 4, liquid sludge land application, would provide the most beneficial long-term employment impact. The sizable increase in employees required relates to the logistics of transporting and applying liquid sludge as opposed to dewatered sludge or compost.

Since overall staffing requirements at the Des Moines Treatment Plant will only increase by about six employees, long-term employment impacts, although beneficial, will be minimal.

Short-Term Employment

Short-term employment for the construction of the solids processing and handling portions of the Des Moines Regional Treatment Plant will represent a small fraction of the construction labor force required to implement the Des Moines ICA 201 Plan. The level of detail currently available regarding allocations of capital costs among labor and materials is not sufficient to make reasonable estimates of construction employment. Consequently, only order of magnitude judgments can be made regarding short-term employment impacts among the alternatives under consideration.

Obviously, the No-Action Alternative would stimulate the least number of short-term construction jobs. Any jobs created would be associated with the upgrading of existing solids processing, handling, and disposal facilities.

Virtually no distinction between short-term employment impacts can be determined among the other alternatives, particularly if it is assumed that the landfilling alternative would involve the utilization of the existing landfill facility. If a new landfill was constructed for the exclusive purpose of sewage solids disposal, then Alternatives 3 and 6 would be expected to generate a limited number of additional short-term jobs than the other "build" alternatives.

Agricultural Economy

With the exceptions of the No-Action and landfilling alternatives, the agricultural economy in the area would be aided by the considered alternatives.

Alternatives 1, 2, and 4 will provide a local source of fertilized soil conditions, a resource of vital importance to area farm operations. The nutrient benefit value of the design production capacity of approximately 38 tons per day of dried sludge solids is worth nearly $0.5 million per year at present prices.

The productivity increases resulting from sludge or compost application will undoubtedly vary among the individual farms using the material. Pilot tests will be conducted by the ICA agency to verify and demonstrate locally the general increased productivity results achieved elsewhere. For example, in well-managed sludge application programs, there have been 2- to 4-fold increases in forage production, 2.5-fold increases in wheat production, and 20 percent higher corn yields than were achieved by commercial fertilizer (Chaney, 1973). Mismanagement of the sludge or compost application on farms could have adverse economic impacts. Application rates in excess of those recommended by soil scientists or agronomists could limit productivity due to high nitrate or heavy metal levels.

With the land reclamation alternatives, approximately 1,000 acres every two years could be returned to agricultural production. This beneficial, long-term impact would occur in Marion County.

Land Values

The No-Action Alternative is expected to have no impact on surrounding land values since these areas are presently affected by existing solids management facilities and practices.

Alternatives 1, 2, and 4 are expected to provide free or inexpensive fertilizer/soil conditioners for agricultural operations surrounding the ICA. This will probably have a positive impact upon land values based on the assumption that the sludge or compost will improve the productivity of the lands which receive it. This assumption seems justified by the evidence from other areas which have used digested or composted sludge as fertilizer including Chicago, Orlando, Denver, and Milwaukee.

Due to the size of the liquid sludge storage area required for Alternative 4 (i.e., 80 acres total), adverse impacts on land values in the vicinity of the storage lagoon(s) may be realized. This impact could be minimized by locating necessary storage facilities in rural areas sufficiently distant from residential areas or other land uses which might experience adverse aesthetic (visual and odor) impacts attributable to sludge lagoons. Due to the relatively small storage capacity required for Alternative 1 and 2 (i.e., 3 acres total) similar effects to those described for Alternative 4 are not anticipated so long as these storage sites are located away from residential areas.

Alternatives 3 and 6, involving landfilling of dewatered or composted sludge, have the potential for adversely affecting land values if new landfill facilities are constructed for the exclusive disposal of sewage solids. Historically, landfills have been associated with a wide range of environmental problems and public nuisance. Because of this public perception, regardless of environmental control designs and nuisance abatement measures, land in the vicinity of a disposal facility is considered less desirable, particularly for intensive development purposes, than land at more distant locations.

If, however, the existing Metro East Landfill is utilized for sewage solids disposal, as is the present practice, impacts to land values would be insignificant. This determination is attributed to the fact that the present facility has been in existence for a number of years, and land value impacts attributable to its location have already been realized.

Proper landfill siting and design efforts, incorporating a strong public participation component, can mitigate, to a certain degree, adverse impacts to land values. However, some degree of negative influence on land values must be considered an unavoidable consequence of landfilling.

Project Costs

The implementation of any one of the project alternatives will entail the long-term, permanent commitment of financial resources to retire the capital cost debt of the facilities and to finance annual operation and maintenance expenditures. For comparative purposes, present worth costs are utilized. Present worth costs have been defined for sludge processing and sludge disposal. Table 29 indicates the present worths of Alternatives 1 through 7.

ARCHAEOLOGICAL AND HISTORICAL INVOLVEMENT

Evidence currently available indicates that the Des Moines River Valley was rather intensively occupied by prehistoric cultures (Gradwohl, 1974). There is a considerable amount of material associated with cultures dating from around the first century A.D. with some materials possibly indicating cultures as early as 5000 to 10,000 years B.C.

As stated in the "Affected Environment" chapter, seven known archaeological sites and a historic structure are present within the general areas preferred for sludge land application. With regard to the representative sites chosen for analysis, no archaeological or historical sites have been documented (Anderson, 1981), although the potential for finding cultural remnants on Sites 1, 2, and 3 exists.

A records search conducted by the Iowa State Historical Department revealed that no known archaeological sites are present proximate to the proposed regional wastewater treatment facility. Consequently, the potential for adversely affecting cultural resources through the construction and operation of sludge processing facilities associated with the project alternatives is small. If cultural artifacts are discovered during construction, all earth moving activities should cease immediately; and the State Historic Preservation Officer (SHPO) should be notified. The SHPO will provide guidance for recovery and preservation of any artifacts found.

Since the demolition or removal of structures (other than those at the Des Moines Main Plant) is not anticipated for any of the sludge management alternatives, no adverse historical involvements will be encountered.

Alternatives 3, 5, 6, and 7 will not adversely impact archaeological resources of the area. No remote storage facilities are required, and sewage solids will be disposed in an existing sanitary landfill (Metro East) or in abandoned coal strip mine sites. Since any evidence of prehistoric habitation of the proposed disposal sites has been destroyed by previous earth moving activity, no adverse archaeological impacts are likely under these alternatives.

TABLE 29

PRESENT WORTH OF PROJECT ALTERNATIVES

	Alternative									
	1a	1b	2	3a	3b	4	5	6	7a	7b
Present Worth Sludge Processing ($ x 10^6)	27.5	28	25.5	27.5	28	20.5	25.5	25.5	27.5	28
Present Worth Sludge Disposal ($ x 10^6)	2.5	2.5	1.5	1.5	1.5	6.0	1.5	1.5	1.5	1.5
Total PW Costs ($ x 10^6	30.0	30.5	27.0	29.0	29.5	26.5	27.0	27.0	29.0	29.5

The potential for adverse impacts upon archaeological resources under Alternatives 1, 2, and 4 is minimal. Alternatives 1 and 4 require remote storage facilities. Since a moderate amount of earthwork may be entailed with such facilities, the potential for adversely affecting cultural resources exists. As a mitigative measure, once specific sites for sludge storage are identified, coordination with the State Historic Preservation Officer (SHPO) should be initiated and his recommendations followed.

Disposal of sludges under Alternatives 1, 2, and 4 will be by land application on agricultural, residential, or parkland. Since land application of sludges disturbs only the plow layer and sludges will primarily be applied to cultivated cropland, no adverse impacts are anticipated since previous cultivation would have disturbed any such sites. Broadcast spreading of compost requires no disturbance of the soil surface. No information concerning the effects of sludge leachate on cultural remnants is available.

In summary, Alternatives 1, 2, and 4 have the greatest potential for adversely affecting archaeological resources since these will involve some excavation associated with remote storage facilities. Of the three, Alternative 4 poses some additional risk because the storage facility size requirement is much greater (80 acres compared with 3 or 4 acres). Such impacts can be avoided through coordination with the SHPO and the conduction of archaeological surveys of storage sites when they are proposed. Consequently, no adverse impacts should result from the considered project alternatives.

RECREATION

It is anticipated that the alternative solids handling systems will not have any measurable long-term impact upon recreation or recreational facilities in the area. No recreational lands would be created, lost, or utilized over the long-term as a consequence of the project alternatives.

There is the potential that a limited amount of parkland within the ICA might be utilized for pilot tests to demonstrate the effects of sludge application on typical crops grown within the area. However, land adjacent to the treatment plant is also under consideration for this purpose. If parkland was utilized, public access to the test plots would have to be restricted for a two-month period following sludge application per IDEQ Rules Title IV, Chapter 33.2(5)K. Hunting on sludge-amended farms may also be restricted if sludge is applied less than two months prior to the hunting season due to Rule 33.2(5)K. These minor short-term impacts would be associated with Alternatives 1, 2, and 4.

It is also noted that the Polk County Conservation Commission plans to turn the Metro East Landfill (proposed for utilization under Alternatives 3 and 6) into a winter recreation area upon closure. Since the landfill currently receives most of the sludge generated in the ICA and plans for the site have been formulated, Alternatives 3 and 6 are considered to have an insignificant impact in this regard.

TRANSPORTATION

The proposed project could have a variety of direct impacts on transportation facilities which will serve either the remote temporary sludge storage facilities or the ultimate sludge disposal sites. Average daily traffic (ADT) will increase; roadways will deteriorate; highways might become littered; and dust will be generated as a consequence of sludge trucking.

Secondary impacts may stem from accidental sludge spillage on roadways. However, spillage associated with Des Moines Main Plant sludge transport operations has been limited to minor leakage. No such problems have been reported during the last five years of operation.

No-Action Alternative

Under the No-Action Alternative, the current situation would continue. Presently, some 6,752 sludge haul trips occur annually within the ICA. Of this total, approximately 2,500 originate at the Des Moines Main Plant and terminate at the Metro East Landfill. An additional 662 sludge hauls also terminate at the Metro East Landfill, most of which are associated with the Des Moines Highland Hills treatment plant. The remaining sludge hauls originate at the other municipal wastewater treatment plants in the ICA and terminate at various land application sites. Generally, these hauls are less than three miles one way. No major problems with traffic congestion, spillage, or nuisances associated with current sludge transport operations have been reported.

Land Application of Dewatered Sludge or Compost (Alternatives 1 and 2)

Average daily traffic will increase on roadways serving the proposed regional wastewater treatment plant; the remote temporary sludge storage facilities; and, to a lesser extent, the land application sites. The majority of this traffic will be concentrated on such roadways as IA 46, IA 163, IA 5, and US 65-69 which will most likely be the primary routes utilized to access the remote storage and land application sites. The impact declines as roadway travel radiates away from the proposed regional wastewater treatment plant located on IA 46.

Sludge Haul Trips

Given an average daily dewatered sludge production of 200 cubic yards or approximately 180 tons, a tractor-trailer capacity of 20 tons, and 220 haul days per year, annual truck haul traffic will total about 4,182 trips per year or nearly 1,700 more trips than which presently originate at the Des Moines Main Plant. This same estimate of annual trips holds true for compost hauling considering the larger volume (250 cubic yards) but reduced tonnage (135 tons). On a daily basis, this amounts to an additional 8 trips per day on IA 46. Such an increase will not adversely affect traffic flow on IA 46 or other primary routes. Present traffic volume (ADT) on IA 46 ranges from 6,820 to 7,430, with the number of tractor-trailer traffic ranging from 174 to 183 trips per day (Iowa Department of Transportation, 1980).

Sludge Distribution Trips

For the purpose of this impact assessment, it was assumed that two remote storage sites would be utilized in both Alternatives 1 and 2. Although no locations for these storage sites have been identified, it was assumed that these storage facilities would be located at representative Sites 2 and 3. Moreover, it is assumed that all land application sites are located within a 5-mile radius of the storage sites. Under these assumptions and given a 100-day per year application period and an application truck capacity of 12 tons, annual application truck traffic will total about 5,000 trips. With a delivery period of 100 days per year and assuming 2,500 trips originating from each storage site, daily truck traffic will total 25 trips. Since ADT on County Road G-24 presently ranges from 887 to 1,169, this increase is not considered significant. However, this same increase on roads serving Site 3 could represent a 50 percent increase in ADT. This increase would not, however, be expected to greatly accelerate the deterioration of this bituminous and metal surfaced roadway.

Highway Bridge Capacity

A potential problem is inherent in the fact that highway bridges in some areas have posted capacity limits below 28 tons, the assumed average distribution truckload (tractor-trailer transport vehicles are assumed to have a gross weight of 36 tons). IA 46, for example, which could provide primary access to northeastern Warren County, includes bridge number 8454 with a posted weight limit of 10 tons (Harrington, 1981). The routing of both transport and distribution trucks will, therefore, require consideration of bridge capacities in order to avoid accidents and bridge damage.

Roadway Deterioration

It is expected that deterioration of road conditions will accelerate as a consequence of increased average daily traffic associated with the conveyance of sludge in both transport and distribution trucks. Gross vehicle weights are estimated at 36 tons for tractor-trailer transport trucks and 28 tons for distribution (application) trucks. Most state and county primary roads have design capacities adequate for such loads and are presently used by agriculture-related and tractor-trailer trucks carrying similar loads. The most significant impacts will occur to those roads not programmed for improvement but utilized for sludge conveyance. To mitigate these impacts, close coordination with the respective county engineering departments should be maintained throughout the development and operation of the land application program.

Sludge Spillage in Transit

Load spillage on haul routes is another potential problem related to the sludge transit and distribution operation under Alternatives 1 and 2. Spillage occurring on roadways under the existing conditions has been limited to minor leakage from sludge conveyance trucks. Because significantly more haul miles (nearly four times as many miles) are associated with Alternatives 1 and 2 than with the No-Action Alternative, the potential for spillage and littering is assumed to be about four times as great as that under the present operation. The potential for spillage can be controlled through proper equipment maintenance and operation and driver safety education programs.

Landfilling of Dewatered Sludge and Compost (Alternatives 3 and 6)

Average daily traffic will increase on roadways serving the proposed regional wastewater treatment plant and the Metro East Sanitary Landfill. These routes include IA 46 and IA 163.

Sludge Haul Trips

Utilizing the same assumptions and design basis employed for Alternatives 1 and 2, annual sludge haul trips between the wastewater treatment plant and the Metro East Sanitary Landfill will total 4,182 trips per year, approximately 1,700 more trips than which presently originate at the Des Moines Main Plant. Seasonal load limits for haul routes are not a factor under the landfilling alternatives. Therefore, assuming 300 haul days per year, average daily traffic will increase by approximately 6 trips per day on IA 46 and IA 163. Such an increase will not adversely affect traffic flow on either of these routes. Present traffic volume (ADT) on IA 46 ranges from 6,820 to 7,430, with tractor-trailer traffic ranging from 174 to 183 trips per day. ADT on IA 163 along the haul route ranges from 4,090 to 22,700, with 307 to 549 tractor-trailer trips per day (Iowa Department of Transportation, 1980). No sludge distribution trips are associated with the landfilling alternatives.

Highway Bridge Capacity

No problems with highway bridge capacities are associated with the landfilling alternatives. No bridges along the anticipated haul routes have posted weight restrictions.

Roadway Deterioration

Accelerated roadway deterioration under the landfilling alternatives is anticipated to be negligible. An additional 1,700 tractor-trailer trips per year over IA 46 and IA 163, which are designed to carry high truck traffic volumes, will not appreciably reduce the service lives of these roadway facilities. Further, because both routes are primary routes within the ICA, it is assumed that they will continue to be maintained in top service condition.

Sludge Spillage in Transit

Load spillage potential is somewhat greater than for the No-Action Alternative but greatly reduced from that associated with the land application and land reclamation alternatives. The degree of potential is directly related to the number of haul miles projected for each alternative. The anticipated annual haul miles for each alternative are provided in Table 30.

Land Application of Liquid Sludge (Alternative 4)

Of all considered alternatives, land application of liquid sludge would have the greatest adverse impact on transportation within the ICA. This determination stems from the unusually high number of sludge hauls per year and the exceptionally high number of annual haul miles required.

Average daily traffic will increase on roadways serving the proposed regional wastewater treatment plant; the remote temporary sludge storage facilities; and, to a lesser extent, the land application sites. The majority of this traffic will be concentrated on such roadways as IA 46, IA 163, IA 5, and US 65-69 which will most likely be the primary routes utilized to access the remote storage and land application sites. The impact declines as roadway travel radiates away from the proposed regional wastewater treatment plant located on IA 46.

Sludge Haul Trips

Given an average liquid sludge production of 305,000 gallons per day, a tractor-trailer capacity of 5,500 gallons, and 220 haul days per year, annual truck haul traffic will total about 20,240 trips per year or 17,740 more trips than which presently originate at the Des Moines Main Plant. On a daily basis, this amounts to an additional 81 trips per day on IA 46. Such an increase could adversely affect traffic flow on IA 46 and other primary routes since this volume represents a 44 to 47 percent increase in tractor-trailer traffic on IA 46 over present conditions.

Sludge Distribution Trips

Utilizing the same set of assumptions employed for Alternatives 1 and 2 under this heading and given an application truck capacity of 4,000 gallons, annual application truck traffic will total about 27,700 trips. Considering a delivery period of 100 days per year and assuming an equal number of trips originating from either of the two storage sites, daily truck traffic will total approximately 139 trips. This would represent a significant increase in daily traffic on roadways serving both sludge storage sites ranging from approximately 12 to 16 percent on County Road G-24 and nearly a 280 percent increase on roads serving Site 3.

Highway Bridge Capacity

Potential problems with bridge capacity similar to those described for Alternatives 1 and 2 are also anticipated for this alternative. The estimated weights of the liquid sludge transport and application vehicles are 40 and 34 tons, respectively, while some bridges have posted weight limits far below these figures. Bridge capacity problems are compounded

TABLE 30

ESTIMATE OF TRAFFIC AND HAUL MILES FOR SOLIDS MANAGEMENT ALTERNATIVE

Alternative	Number of Hauls per Year	Total Haul Miles per Year
No-Action Alternative	6,752	101,424
Alternative 1 - Land Application of Dewatered Sludge:		
Tractor-Trailer Transport	4,182	328,404
Distribution (application) vehicles	5,000	50,000
Totals Alternative 1	9,182	378,404
Alternative 2 - Compost Marketing:		
Tractor-Trailer Transport	4,182	328,404
Distribution (application vehicles	5,000	50,000
Totals Alternative 2	9,182	378,404
Alternative 3 - Landfilling Dewatered Sludge	4,182	119,316
Alternative 4 - Land Application of Liquid Sludge:		
Tractor-Trailer Transport	20,240	1,720,400
Distribution (application) vehicles	27,700	277,000
Totals Alternative 4	47,940	1,997,400
Alternative 5 - Land Reclamation with Compost	4,182	310,804
Alternative 6 - Landfilling Compost	4,182	119,316
Alternative 7 - Land Reclamation with Dewatered Sludge	4,182	310,804

by the fact that this alternative requires far more truck trips (see Table 30) and consequently a higher potential for conflicts between truck weights and bridge capacities than that associated with other alternatives. To avoid accidents and bridge damage, the routing of trucks will require consideration of bridge capacities.

Roadway Deterioration

Roadway deterioration will accelerate at a greater rate under this alternative than with any other under consideration because more truck trips are required. Roadway deterioration will occur as a consequence of increased truck usage associated with the conveyance of liquid sludge. Most primary roads have design capacities adequate for liquid sludge truckloads. However, the extensive number of truck hauls required on secondary roads associated with sludge application must be viewed as a potentially significant adverse impact, particularly if such roads are not programmed for improvement by the respective county engineering departments. To mitigate roadway deterioration problems, close coordination between the ICA agency and the county engineering departments should be maintained throughout the development and operation of the liquid sludge land application program.

Sludge Spillage in Transit

Load spillage on haul routes is a potential problem related to the distribution operation. While the trucks utilized for transport are fully enclosed tank-type trucks, spillage could occur as a result of malfunctioning valves, collisions, accidents, or operator error. Because this alternative involves significantly more hauls and haul miles, the potential for spillage is greater under this alternative than with the others considered. The potential for spillage can be controlled through proper equipment maintenance, operation, and driver safety education programs.

Land Reclamation Utilizing Compost or Dewatered Sludge (Alternatives 5 and 7)

Average daily traffic will increase on routes serving the proposed regional wastewater treatment facility and the mine reclamation sites. These routes include IA 46, IA 5, IA 181, IA 92, and secondary roads in the vicinity of the abandoned strip mines near Flagler in Marion County.

Haul Trips

Utilizing the same assumptions and design basis employed for Alternatives 1 and 2, annual haul trips between the wastewater treatment plant and the reclamation sites will total 4,182 tractor-trailer trips per year. Assuming 220 haul days per year, average daily traffic will increase on the above mentioned routes by approximately 19 truck trips per day. Such an increase will not adversely affect traffic flow on any of these routes since most roads in question are lightly to moderately traveled at present and have design capacities adequate to carry the additional traffic.

As presently envisioned, the tractor-trailer transport vehicles would dispose of their loads directly at the reclamation sites. Therefore, no distribution trips originating at temporary storage sites would be associated with the land reclamation alternatives.

Highway Bridge Capacity

A potential problem is inherent in the fact highway bridges in some areas have posted capacity limits below 36 tons, the assumed average haul truckload. While the potential problem is not as great as that associated with Alternatives 1 and 2, it does exist, most notably with bridge number 8454 on IA 46 which would afford the most direct route from the treatment plant to the reclamation area and has a weight limitation of 10 tons. The routing of transport trucks will, therefore, require consideration of bridge capacities in order to avoid accidents and bridge damage.

Roadway Deterioration

It is expected that deterioration of road conditions will accelerate as a consequence of increased truck usage associated with the conveyance of sludge or compost. However, because the anticipated haul routes will mainly consist of primary roads which presumably receive regular maintenance, this impact will not exceed tolerable limits. Should either of the land reclamation alternatives be implemented, coordination with the respective county engineering department should be initiated and maintained in order that necessary road improvements can be incorporated in its road improvement programming.

Spillage in Transit

Sludge or compost spillage on haul routes is also a potential problem associated with the transport of these materials to the land reclamation area. The potential for spillage directly corresponds to the number of annual haul miles anticipated. As can be interpreted from the data in Table 30, Alternatives 5 and 7 have a spill potential of about three times that associated with the No-Action Alternative. As with the other considered alternatives, the potential for spillage can be controlled through proper equipment maintenance, operation, and driver safety education programs.

Comparison of Transportation Impacts

The transportation impacts of all alternatives stem from the transport of sludge or compost from wastewater treatment facilities to storage and/or disposal locations. Obviously, the greater the number of hauls and haul miles, the greater the impacts to transportation systems (i.e., the highway network). Haul data for each alternative are summarized in Table 30.

The type or classification (primary or secondary) of highway facilities potentially utilized for sludge transport also has a bearing upon the magnitude of transportation impacts associated with the considered alternatives. Those alternatives requiring sludge transport on secondary roads would be expected to have greater adverse effects, particularly with regard to roadway deterioration, than those alternatives requiring the exclusive use of primary highway facilities. The reasons for this are that primary roads are generally designed to accommodate greater truck traffic volumes than secondary roads, and primary roads would be expected to be routinely scheduled for and receive more frequent maintenance and repair than secondary facilities. Alternatives 1, 2, and 4 would require the greatest use of secondary roads; Alternatives 3 and 6 would transport sludge or compost exclusively on primary roads; and Alternatives 5 and 7 would require limited use of secondary roads.

AESTHETIC IMPACTS

Background

The rural regions of the study area are characterized by rolling and hilly topography. While there are no particularly striking features in the agricultural areas, an expansive and restful atmosphere provides a pleasant contrast to the urbanized portions of the ICA. Polk County farms tend to be more heavily committed to crop production, while those in Warren County are used more for pasturing purposes.

The city of Des Moines, with its urban redevelopment program, provides an array of cultural attractions including the gold-domed State Capitol Building. City parks and the riverfront afford settings for many cultural and recreational activities. The area surrounding the treatment plant, however, is comprised of industrial uses.

Visual Impacts

Visual impacts in the vicinity of the proposed regional treatment plant will be minimal under the considered solids management alternatives (SMA's) since solids processing facilities are currently among the landscape features present. The addition, expansion, and/or upgrading of solids processing facilities (i.e., anaerobic digesters, dewatering equipment, and/or composting facilities) in this area will have little impact on the quality of the landscape appearance. The only measurable difference in visual impact among the SMA's at this location is between those alternatives involving sludge composting and those proposing anaerobic digestion. An additional 15 acres of land would be utilized for sludge composting. Consequently, the compost alternatives (Alternatives 2, 5, and 6) would have greater visual impact. This difference is not significant in light of the fact that all solids processing facilities are located in an older industrial area.

Land Application or Reclamation Utilizing Dewatered Sludge or Compost

Land application and land reclamation utilizing compost or dewatered sludge (Alternatives 1, 2, 5, and 7) present few visually adverse aesthetic problems. Since people generally accept the fact that fertilizer must be applied to farmland and mine spoil sites and since dried sludge or compost does not have a particularly offensive appearance, no significantly adverse visual impacts are expected at disposal sites under these alternatives. In fact, the land reclamation alternatives (Alternatives 5 and 7) would have a long-term beneficial effect since denuded mine spoil sites would be reclaimed to support vegetation native to the area.

Visual impacts associated with remote storage facilities because of their small size, location away from populated areas, and the inert appearance of dewatered sludge or compost will be minimal.

Land Application of Liquid Sludge

Visual impacts of concern under Alternative 4 relate to the required storage facility. Under this alternative, approximately 80 acres are required to store liquid sludge during those parts of the year when sludge cannot or should not be applied. Even under the assumption that several sites would be utilized for liquid sludge storage, the acreage required per site would be considerable. Since these storage sites would consist of shallow lagoons or ponds and the appearance of liquid sludge is black, the storage sites would be visually offensive to most observers. Locating storage facilities in visually remote areas away from population centers and transportation corridors, together with use of natural vegetative screenings, would reduce this adverse visual impact.

The visual impact of applying liquid sludge to farmland is minimal. Since the sludge would be injected, little visual evidence, not dissimilar to a freshly plowed field, would be apparent.

Landfilling

Alternatives 3 and 6 propose landfilling of dewatered and composted sludge, respectively. While landfill sites are not visually appealing, if properly located and screened, they can exhibit little or no visual intrusion to observers not immediately on the disposal site. Such is the case with the Metro East Landfill (PEDCo Environmental Inc., 1980). Assuming that the present landfill would continue to receive sewage solids, no adverse visual impacts would be encountered.

No-Action Alternative

Since the No-Action Alternative constitutes continuance of existing solids management operations within the ICA (i.e., combination of landfilling and land application), no additional visual impacts, either beneficial or adverse, will occur.

Odors

The odor producing potentials of the various sludge management alternatives are discussed in detail as part of the air quality impact analysis. Odors were found to cause only minor environmental impact because of the following factors:

- Rural location of the disposal area
- Familiarity of generated odors to the farming community
- Site management practices designed to reduce odor production, such as minimized stockpiling, covering, subsurface injection of liquid sludge, and proper surface loadings

- Studies which have demonstrated low odor producing potential for similar sludge management operations

For purpose of comparison, Alternative 4 is expected to have the greatest adverse odor impact of the considered SMA's. This is due to 1) the fact that liquid sludge is more odorous than either dewatered or composted sludge and 2) odor production problems associated with liquid sludge storage. Little measurable difference between odor impacts of the other SMA's exists. In this regard, landfilling and land reclamation present the least potential for adverse odor impacts since the disposal of sewage solids is more geographically limited; and potentially fewer people would be exposed to odors than would be expected under the land application alternatives.

PUBLIC HEALTH

Introduction

The agencies charged with maintenance of the public health in Polk and Warren counties are the respective county health departments. These agencies, however, are not responsible for monitoring public wastewater treatment facilities or sludge disposal operations. The Iowa Department of Environmental Quality (IDEQ) is charged with this task. IDEQ is also responsible for permitting wastewater dischargers and sludge disposal operations. IDEQ has also established criteria to ensure that heavy metals in sludge (zinc, copper, cadmium, etc.) will not harm plants or the soil. Further, IDEQ has established regulations to protect public health by restricting sludge application on certain crops that may be consumed by humans (IDEQ Rules, Chapter 33). As a result of this project, the IDEQ's monitoring activities may need to be expanded to cover the selected disposal sites receiving sludge. This may increase the manpower requirements of the department.

The significance of sludge disposal for public health centers around the ultimate fate of contaminants which are present in sewage sludge. These contaminants can be classified into the following major categories:

- Elemental Contaminants - elements and their various chemical forms (e.g., heavy metals).

- Biological Contaminants - pathogenic agents can be classified into four groups: viruses, bacteria, protozoans, and intestinal worms (helminths). The adult forms of the latter two perish quickly outside of their hosts; however, the cysts of protozoans and ova of helminths do survive and are very persistent in wastes.

- Other Wastewater Contaminants - common constituents of wastewater which may be in high concentrations in sludges (e.g., nitrogen and phosphorus species).

- Synthetic/Organic Contaminants - a variety of chemicals which have been introduced as a consequence of industrialization such as biocidal chemicals and organic chemicals produced by treatment processes.

The various pathways, direct and indirect, by which these contaminants may travel from sludge to land and eventually to man are complex and not completely understood and include aerosols, groundwater contamination, plant uptake, bioaccumulation, and direct ingestion.

The effect that contaminants may have on public health depends on the solids disposal method used. Possible ramifications on public health are described below.

Health Factors Related to Anaerobic Digestion

There are a number of factors which help to ensure that the potential health hazards associated with sludge will not be realized to the extent of creating actual health problems. The anaerobic digestion process destroys many of the human pathogens. Fecal coliforms, an indicator of pathogens, are reduced by 97 percent or more in a well-run anaerobic digester (EPA, 1975). Anaerobically digested sludge is generally considered biologically safe to use on farm crops without further treatment (Chaney, 1973). Eggs and cysts of enteric parasites are able to survive the digestion process and remain alive for relatively long periods of time. The subsequent drying and soil incorporation processes are deadly to pathogens due to the exposure to ultraviolet light, desiccation, and unsuccessful competition with the indigenous soil organisms. However, many parasites have long survival periods in the soil in cyst form or in the egg stage. Long-term storage of sludge is an effective reducer of pathogenic organisms (Dotson, 1973). Storage of liquid digested sludge for 60 days at 20° C (68° F) or 120 days at 4° C (40° F) has been reported to be a successful pathogen reduction measure (EPA, 1975).

Limitations on Sludge Management

Biological health hazards associated with sludge include pathogenic bacteria, viruses, and parasites which may have survived the initial treatment process. Statements about viral health problems must be more guarded and uncertain because of the difficulty in measuring viruses and the lack of standards for virus levels. In general, however, viruses are more short-lived than bacterial pathogens (CEQ, 1974). Intestinal parasites may also be present in various forms in the sludge. Other biological hazards associated with sludge are such disease-carrying vectors as flies, mosquitoes, and rats.

The survival times of various pathogens associated with sewage sludge are given in Table 31. *Ascaris* ova (eggs of a parasitic worm) are particulary long-lived and, thus, are good indicators for monitoring the general sanitary quality of the sludge. *Salmonella*, relatively common pathogenic microorganisms, are also excellent indicators.

A large body of literature has been developed in conjunction with sludge handling operations in Virginia and Maryland. Indications from this work are that high levels of organisms, up to 1,500 organisms M^3, can exist in the vicinity of such operations (Cookson, 1981). Both Maryland and Virginia have instituted air monitoring programs for these operations.

TABLE 31

SURVIVAL TIMES OF PATHOGENIC MICROORGANISMS IN VARIOUS MEDIA

Organism	Medium	Type of Application	Survival Time
Ascaris ova	soil	not stated	2.5 years
	soil	sewage	up to 7 years[1]
	plants and fruits	AC[2]	1 month
Cholera vibrios	spinach, lettuce	AC	22 to 29 days
	cucumbers	AC	7 days
	nonacid vegetables such as onions, garlic, oranges, lemons, lentils, grapes	AC	2 days
	rice and dates	infected feces	hours to 3 days
Endamoeba histolytica cysts	river water	AC	8 to 40 days
	soil	AC	8 days
	tomatoes	AC	18 to 42 hours
	lettuce	AC	18 hours
Enteric viruses	roots of bean plants	AC	at least 4 days
	soil	AC	12 days
	tomato and pea roots	AC	4 to 6 days
Hookworm larvae	soil	infected feces	6 weeks
Leptospira	river water	AC	5 to 6 days
	soil	AC	15 to 43 days
Salmonella typhi	dates	AC	68 days
	harvested fruits	AC	3 days
	apples, pears, grapes	AC	24 to 48 hours
	strawberries	AC	6 hours
	soil	AC	74 days
	soil	AC	70 days
	soil	AC	at least 5 days
	pea plant stems	AC	14 days
	radish plant stems	AC	4 days
	soil	AC	up to 20 days
	lettuce and endive	AC	1 to 3 days
	soil	AC	2 to 110 days
	soil	AC	several months
	lettuce	infected feces	18 days

TABLE 31 (continued)

SURVIVAL TIMES OF PATHOGENIC MICROORGANISMS IN VARIOUS MEDIA

Organism	Medium	Type of Application	Survival Time
Salmonella typhi (continued)	radishes	infected feces	53 days
	soil	infected feces	74 days
	soil	AC	5 to 19 days
	soil	AC	70 to 80 days
	cress, lettuce, radishes	AC	3 weeks
	lake water	AC	3 to 5 days
Salmonella (other than typhi)	soil	AC	15 to 70 days
	vegetables	AC	2 to 7 weeks
	tomatoes	AC	less than 7 days
	soil	sprinkled with domestic sewage	40 days
	potatoes	sprinkled with domestic sewage	40 days
	carrots	sprinkled with domestic sewage	10 days
	cabbage and gooseberries	sprinkled with domestic sewage	4 days
Shigella	streams	not stated	30 minutes to 4 days
	harvested fruits	AC	minutes to 5 days
	market tomatoes	AC	at least 2 days
	market apples	AC	at least 6 days
	tomatoes	AC	2 to 7 days
Tubercle bacilli	soil	AC	6 months
	grass	AC	14 to 49 days
	sewage	?	3 months
	soil	?	6 months

[1] Under warm, moist conditions not encountered in the Des Moines area.
[2] AC = Artificial Contamination

SOURCE: Council on Environmental Quality and EPA, 1974

Of major concern are allergic responses of sludge handling personnel and the role of the secondary pathogens present in the air. Secondary pathogens are those which produce infection in susceptible individuals, i.e., those with predisposing health conditions, but not in healthy subjects. No primary pathogens have been noted in air samples (Cookson, 1981). Organisms which have been recovered are 90 to 98 percent gram positive bacteria which is indicative of nonpathogenic and nonallergic response inducing organisms. However, three secondary pathogens, *Enterobacter agglomerians*, *Klebsiella sp*., and *Aspergillus fumigatus*, have been noted (Cookson, 1981).

Conclusions drawn to date are that sludge handling operations do not pose a threat to the health of the general community. Levels of bacteria in the air in the immediate vicinity of the operations are typical of those found in normal agricultural operations such as field preparation, harvesting, and haying. Risk to susceptible individuals can be mitigated by site selection remote from hospitals, schools, and other health care facilities. Medical screening and surveillance of employees can effectively protect their health. The use of respiratory protective devices can also be used effectively. Management of the operations at the sludge handling facility, as discussed under the "Air Quality" section, including covering of stockpiles, covered trucks, and minimized material handling, can further reduce adverse impact to a negligible level.

Site Restrictions and Food Production

The long survival time observed for viruses and *Ascaris* ova makes it imperative that 1) no food crops be raised on sludge-amended soil to be eaten directly (unprocessed, raw) by humans; 2) long field reentry periods be established and strongly enforced on areas where sludge is applied; 3) cases of disease contracted from sludge sources be identified, documented, and followed through; and 4) a very rigorous public health monitoring program be established as an integral part of the reuse of sludge on food crops of all types.

The pathogen problems associated with dried sludge disposed of at the land application, landfill, or land reclamation sites will be somewhat less intensive than the anaerobic or dewatered sludge at the wastewater treatment plant because of the natural die-off of the pathogens with time. However, the greater possibilities for human contact bring up additional possible public health impacts. If sludge is used to fertilize crops which will be eaten raw within the first year of application, adverse health impacts could well result. If the one-year wait is observed, no significant health impact is expected. Recommended waiting periods of from one year (Chaney, 1973) to three years (EPA, 1973) between sludge application and growing of crops to be eaten raw have been suggested. However, since IDEQ rules forbid the application of sludge on land for the commercial production of human consumption food crops, associated public health impacts are greatly minimized.

Crops typically grown on area farms are primarily corn, soybeans, and, to a lesser extent, oats, sorghum, and wheat. From the point of view of preventing heavy metals accumulation in the food chain, more suitable cropping patterns would be hard to accomplish. The parts of these plants which are used for animal feed and/or processed for human consumption are not known to be accumulators of cadmium or any other heavy metals. It is not expected that cropping patterns will change appreciably in the future years; hence, it is expected that no significant food chain hazards will exist with sludge reuse on farms near the ICA.

Sludge application in excessive amounts on pasture land may result in accumulation of cadmium and other heavy metals in the leafy parts of some weeds. Domestic animals feeding in these pasture lands will, in time, accumulate these elements in their tissues and pass them along to humans who eat the meat (especially liver and kidneys). As long as recommended application rates are not exceeded, excessive accumulations are not expected to occur.

The other elements of major concern to the food chain, including copper, zinc, molybdenum, selenium, and lead, are either of sufficiently low concentration in the Des Moines sludge or their toxicities are less acute so that they are not expected to produce an adverse impact upon the food chain. Also, most toxic metals sharply reduce crop yields before they become high enough in concentration to pose a food chain hazard. This phenomenon constitutes a safety valve in the food chain. Additionally, organic compounds in sludge are able to chelate heavy metals, making them even less available.

Lastly, another effective solution to heavy metal magnification problems in the food chain is reduction of the quantities of heavy metals in the wastewater system from industrial or other sources. This is presently being pursued via the Industrial Pretreatment Program contained in the 201 Study.

Other Wastewater Contaminants

The principal pollutant of concern in this category is the leaching of nitrates into the groundwater aquifer. Nitrates, if applied in amounts greater than can be removed by plant uptake, can contaminate groundwater and may cause human and animal health problems. Excessive nitrates in drinking water can result in methemoglobinemia. Methemoglobinemia is caused when nitrate is reduced to nitrite in the gastrointestinal tract which then enters the bloodstream and reacts with hemoglobin to impair oxygen transport. The U.S. EPA drinking water standard is 45 mg/l of nitrate-nitrogen (NO_3-N). If the concentration rises above this level, usage of sludge should be curtailed and the groundwater restricted from potable use. Such a measure would be most appropriate in the vicinity of shallow groundwater supplies used for domestic purposes. Under a well regulated land application program, however, where application rate control is based on fertilizer nitrogen requirements and heavy metals accumulation, little nitrate should enter the groundwater; and the potential health risks can be minimized.

Additional discussion on this topic is given under the section dealing with groundwater contamination.

No-Action Alternatives

Continuation of the present landfill operation at Metro East and sludge application at other various sites in the ICA should not pose any serious health hazards. There have been no reported cases of infection or disease at any of the sites nor have nearby neighbors voiced any objections to the sludge management operations from a health standpoint. Also, the small quantities of sludge that are disposed of by low-rate land application at the various scattered sites contain no industrial effluent inputs.

Agricultural Land Application and Strip Mine Reclamation

The potential hazards associated with land disposal are highly dependent on several factors including the quality of the sludge or product, the rate of application, the cumulative loading, the crop or grasses grown on sludge amended soil, and the chemical and physical nature of the soil.

In general, it appears that there is little evidence for the dissemination of disease to humans or animals by stockpiling, transporting, and land spreading of digested sewage sludge. Pathogens are readily removed by soils through filtration, sorption-inactivation, and die-off. Pathogen movement is usually limited to within a few feet from the source unless the soil is of very coarse texture or contains cracks and channels.

Aerosols associated with the distribution of liquid sludges, however, usually contain quantities of pathogens that remain in the atmosphere above the application site. Prevailing winds can transport these pathogens considerable distances before they ultimately settle out. Careful study of prevailing wind patterns and downwind land uses should be undertaken if liquid sludge land application is selected as the disposal technique. It is anticipated that this alternative would result in a moderate adverse impact upon the environment. This impact will be mitigated through direct injection of liquid sludge into the soil.

The liquid sludge land application mode will require storage lagoons totaling approximately 80 acres in size in order to contain the sludge during periods when it cannot be applied due to unacceptable weather or soil conditions. Aerosols resulting from the wind action on the surface of the lagoons will be more difficult to control. Consequently, the adverse impacts are greater than those associated with the subsurface or simple ground surface application techniques. A lagoon liner of strong, impermeable material will be necessary to provide adequate groundwater protection, particularly from nitrate leachate. Vector problems (flies, mosquitoes, etc.) are also associated with liquid sludge storage.

Landfilling

While landfilling is also subject to both state and federal regulation, the potential for public health impacts through contamination of groundwater is a cause for concern, mainly because of historical incidents nationwide and the difficulty in reversing the problem once encountered. However, strict adherence to design criteria in the IDEQ regulations can substantially reduce such problems. Of particular concern will be the need for a soil and groundwater monitoring system to evaluate environmental quality. On-site wells around the perimeter of the landfill sites and other nearby wells should be used to monitor approximately 15 biological and chemical parameters. Typically, these parameters may include nitrate-nitrogen, heavy metals, and synthetic/organic contaminants (phenols, PCB's, etc.). Mitigation measures for public health hazards should include: 1) provision of special medical services for the employees at the landfill site, 2) restriction of public access to the area, 3) maintenance of optimal digestion conditions in the anaerobic digesters at the wastewater treatment plant to maximize pathogen die-off and methane release before the sludge is received at the site, 4) provision of special medical monitoring and preventive treatment for persons working at the site operating heavy equipment or those who frequent the area by delivering sludge loads, and 5) a strict ban against pumping of undigested sludge at all times.

Composting

The most recent data available indicate that composting, when conducted properly, is a safe means of processing and utilization of sludge. The land application of this material appears to present no danger of the spread of disease from pathogenic organisms. However, while the compost has been referred to as a hygienic product (Burge, et al, 1978), it is not a sterile product because the high temperatures produced during composting are due to the activity of microorganisms within. Certain types of secondary fungal pathogens and microbial allergens have been found at various compost sites from all stages of the composting process (Millner, et al, 1977). These secondary pathogens are commonly found in the general environment, as well, but in lower concentrations. The available literature suggests that potential on-site problems associated with secondary pathogens at composting sites are worthy of precautionary considerations. Aerosolized particles of compost which include conidia or spores of *Aspergillus fumigatus* may pose a health problem for sensitized or otherwise predisposed individuals (Millner, et al, 1977). To reduce the health risk for such individuals who are employed at composting sites, the wearing of respirators, periodic water spraying to minimize dust production and possible dispersal of *A. fumigatus* spores, and the isolation of such workers from the spore-dispersing parts of the process are suggested. In consideration of off-site health matters related to air disposal of spores, a buffer distance between the composting operation and health care facilities or residential areas may be needed. For instance, compost site restrictions or modifications would be necessary if hospitals, dialysis centers, nursing homes, blood collection centers are nearby or downwind in direct contact with high spore concentrations. When potential sites for composting facilities are identified, a site-specific analysis with respect to proximal sensitive receptors, including residences, schools, offices, and medical care facilities, will be conducted. In the actual use of the finished product, generation of dust clouds containing high levels of spores presents a potential exposure problem for hypersensitive persons.

Summary

The public health of persons in the ICA is not anticipated to be measurably impacted. Although the potential exists for the release of some pathogens, these impacts can be mitigated through proper design and careful consideration of adjacent land uses.

SUMMARY COMPARISON OF IMPACTS

This section provides a summary of short-term, long-term, irreversible-irretrievable, and unavoidable impacts of each considered alternative. These impacts are presented in Table 32. Additionally, comparisons of all impacts are summarized here.

As a means of comparing the relative merits of the project alternatives, a scaling weighted checklist system known as the Reference Alternative Method has been adopted for use in the EIS process. The following environmental parameters are considered:

- Ecological Environment
  - Aquatic flora and fauna
  - Terrestrial flora and fauna
- Physical Environment
  - Topography
  - Geology
  - Soils
  - Surface water quality
  - Groundwater quality
  - Air quality
  - Noise
  - Energy
- Socioeconomic Factors
  - Demography
  - Land use and land use plans
  - Economic factors
  - Archaeological/historical factors
  - Recreation
  - Transportation
  - Aesthetics
  - Public health
  - Recreation

Each of these environmental parameters has been assigned weighting factors (parameter importance units - PIU) to reflect its importance relative to the Des Moines ICA Sludge Management Project. The PIU's were developed by an interdisciplinary study team composed of TenEch and Engineering-Science professionals involved in the project.

Factors considered in assigning the PIU's were the following:

- Degree of Project Interaction
- Local Value of the Resource
- Sensitivity of the Environmental Parameter

The key environmental parameters (those with PIU's of 70 points or greater) are soils, groundwater quality, energy, transportation, and public health.

Based upon the information developed describing the potential impacts of each alternative, each environmental parameter was assigned a scaling (environmental quality - EQ) value ranging from -5 (significant negative impact) to +5 (positive impact). The criteria scale is provided in Table 33, while Table 34 indicates the scaling values assigned to environmental parameters for all project alternatives.

To obtain a quantitative measure of the environmental impact, the EQ values were multiplied by the PIU's. These resltinq values, referred to as environmental impact units (EIU's), were summed for each project alternative to arrive at an overall measure of the environmental impact. These data are provided in Table 35.

It should be noted that, to allow a quantitative evaluation of environmental impact of the project alternatives on the affected environment, the existing environmental baseline condition is defined; and all the EIU values are assigned a value of zero. This is so each project alternative can be demonstrated as having a measure of positive or negative impact relative to the defined reference alternative.

Results of Environmental Impact Analysis

A review of Table 35 reveals that the land reclamation alternatives (Alternatives 5 and 7) provide the greatest benefit among the project alternatives, followed by land application and landfilling of dewatered sludge. The primary reason for this is that the baseline conditions of the mine spoil sites are comparably poor when matched against the baseline conditions of the land application or landfill sites. Consequently, although absolute impacts on land reclamation and land application sites are not that different, improvement of the mine spoil sites results in a much greater site-specific beneficial impact.

Table 35 further reveals that land application of liquid sludge (Alternative 4) would have the greatest negative impact, primarily due to adverse socioeconomic factors. Other alternatives which would have an overall negative impact relative to baseline conditions include the No-Action Alternative and Alternatives 2 and 6.

TABLE 32

SUMMARY OF IMPACTS FOR THE DES MOINES I

Impact Category	Alternatives 1a/b	Alternative 2	Alternatives 3a/b	Alternative 4
Short-Term Impacts	Increase in jobs for construction; increased noise and dust at plant during construction; moderate odor and traffic increase associated with sludge applications; restriction of land use following sludge application; reduced local share construction costs.	Increase in jobs for construction; increased noise and dust at plant during construction; reduced local share construction costs.	Increase in jobs for construction; increased noise and dust at plant during construction.	Same as Alternatives 1a/b.
Long-Term Impacts	Moderate traffic increase; minor air and noise pollution from sludge transport; potential deterioration of groundwater and surface water quality due to sludge application; beneficial reuse of nutrients; accumulation of heavy metals in soils; reduced facility energy and agricultural fertilizer requirements; potential vector problems; increased administrative requirements; reduced local share operating costs.	Moderate traffic increase; minor air and noise pollution from compost transport; some increase in airborne pathogens from compost; beneficial reuse of nutrients; accumulation of heavy metals in soils; potential groundwater and surface water deterioration; localized increase in soil productivity if used on marginal soils; increased odors at plant if not operated properly; increased dust and noise at plant; increased administrative requirements.	Minor traffic increase on primary roads only; slight increase in air and noise pollution associated with sludge transport; potential groundwater deterioration near landfill; reduction in landfill life.	Considerable traffic increase and associated roadway deterioration primarily on secondary roads; increased air and noise pollution from sludge transport; potential groundwater and surface water deterioration; odors from sludge storage; beneficial reuse of nutrients; accumulation of heavy metals in soils; potential vector problems; reduction of plant energy requirements but increased use of petroleum-based energy; reduction in fertilizer requirements; high potential for spillage during sludge transport; increased administrative requirements.
Irreversible and Irretrievable Commitment of Resources	No additional land needed for sludge processing; manpower, materials, and energy for construction and operation.	Fifteen additional acres of land for compost processing and storage; manpower, materials, and energy for construction and operation.	No additional land for sludge processing; manpower, materials, and energy for construction and operation; loss of beneficial resources (nutrients in sludge).	No additional land for sludge processing; significant manpower and energy requirements for sludge transport; materials, energy, and manpower for construction.
Unavoidable Impacts	Moderate traffic increase and roadway deterioration from sludge hauling; accumulation of heavy metals in soils; increased administrative requirements; minor increase in air and noise pollution; exposure of terrestrial fauna to heavy metals.	Same as Alternatives 1a/b except energy use is greater.	Minor traffic increase; reduction in landfill life; slight increase in air and noise pollution.	Considerable traffic increase and associated roadway deterioration from sludge hauling; accumulation of heavy metals in soils; odors from sludge storage facility; increased use of petroleum-based energy for sludge transport; increased air and noise pollution.

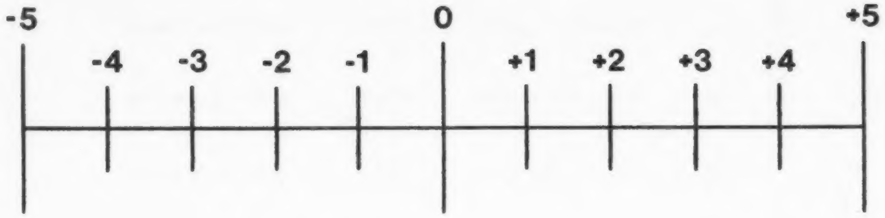
TABLE 32

ES MOINES ICA SLUDGE MANAGEMENT PROJECT

Alternative 4	Alternative 5	Alternative 6	Alternatives 7a/b	No-Action
Alternatives 1a/b.	Increase in jobs for construction; increased noise and dust at plant during construction; increased dust, noise, erosion, and traffic at disposal site; reduced local share for construction costs.	Same as Alternatives 3a/b except local share for construction costs is reduced.	Similar to Alternatives 1a/b with increased dust, noise, erosion, and traffic at disposal site.	No jobs for construction.
erable traffic increase ssociated roadway deteri- n primarily on secondary increased air and noise on from sludge trans- potential groundwater rface water deteriora- dors from sludge stor- neficial reuse of nu- ; accumulation of heavy in soils; potential vec- blems; reduction of energy requirements but sed use of petroleum- energy; reduction in fer- r requirements; high po- for spillage during transport; increased ad- ative requirements.	Minor traffic increase on primary roads; minor increase in air and noise pollution; land returned to productive use; beneficial reuse of nutrients; reduction in surface water and groundwater contaminants (acid mine water); reduction in soil erosion on mine sites; accumulation of heavy metals in soils; possible increase in wildlife habitat; minor increase in property tax base; increased administrative requirements; increased energy use; reduced local share for operating costs.	Similar to Alternatives 3a/b except: reduced potential for groundwater deterioration; reduction in cover material requirements at landfill; elevated dust, noise, odors, and airborne pathogens at plant; reduced local share for operating costs; reduction in landfill life.	Same as Alternative 5 except energy requirements are greatly reduced and topsoil would have to be imported to the disposal site.	Continued loss of nutrients in sludge; reduction in landfill life; potential for groundwater contamination at landfill and land application sites; continued loss of energy produced in sludge digesters; no realization of additional jobs at wastewater treatment plant; problems with landfill operations associated with disposal of inadequately dewatered sludge.
tional land for sludge sing; significant man- and energy requirements udge transport; materi- ergy, and manpower for ction.	Similar to Alternative 2; energy requirements for operation are lower than Alternative 2 but higher than No-Action; accumulation of heavy metals in soils.	Fifteen additional acres for compost processing and storage; manpower, materials, and energy for construction and operation; loss of beneficial resource (nutrients); loss of landfill capacity.	Similar to Alternative 5 except that no additional land at treatment plant is required and manpower and energy re-requirements are reduced.	Manpower and energy for operations; loss of beneficial resource (nutrients in sludge).
rable traffic increase ssociated roadway deteri- from sludge hauling; lation of heavy metals ls; odors from sludge facility; increased petroleum-based energy udge transport; increased noise pollution.	Minor traffic increase; accumulation of heavy metals in soil; increased energy use; increased administrative requirements; increased wildlife habitat; slight increase in air and noise pollution.	Minor traffic increase; elevated dust, noise, odor, and airborne pathogens at plant; increased energy use; reduction in landfill life; slight increase in air and noise pollution levels.	Same as Alternative 5 with lower manpower and energy requirements.	Loss of beneficial nutrients and landfill capacity.

TABLE 33

RANKING CRITERIA



-5 = Irretrievable Destruction of Existing Resources

-3 = Moderate Damage to Existing Resources

-1 = Limited Negative Impact to Existing Resources

0 = Baseline Condition

+1 = Limited Beneficial Impact to Existing Resources

+3 = Moderate Improvement to Existing Resources

+5 = Major Enhancement of Existing Resources

TABLE 34

SCALING OF ENVIRONMENTAL IMPACTS

		Alternatives										
	Baseline	No-Action	1a*	1b	2	3a	3b	4	5	6	7a	7b
Physical Environment												
Topography	0	0	0	0	0	0	0	0	+1	0	+2	+2
Geology	0	0	0	0	0	0	0	0	+1	0	+1	+1
Soils	0	0	+2	+2	+1	0	0	+2	+4	0	+3	+3
Surface Water Quality	0	0	-1	-1	-1	0	0	-2	+1	0	+1	+1
Groundwater Quality	0	-1	-1	-1	-1	0	0	-2	+1	0	+1	+1
Air Quality	0	-1	-2	-2	-2	-1	-1	-3	-2	-1	-2	-2
Noise	0	0	-1	-1	-1	0	0	-3	-2	-1	-2	-2
Energy	0	-1	+3	+3	-2	+3	+3	+2	-2	-2	+3	+3
Ecological Environment												
Aquatic Flora and Fauna	0	0	-1	-1	-1	0	0	-2	+1	0	+1	+1
Terrestrial Flora	0	0	+2	+2	+1	0	0	+2	+3	0	+3	+3
Terrestrial Fauna	0	0	-1	-1	-1	0	0	-1	+2	0	+1	+1
Socioeconomic Factors												
Demography	0	-1	+1	+1	+1	0	0	+1	0	0	0	0
Land Use and Land Use Plans	0	-1	+3	+3	0	0	0	+2	+1	0	+1	+1
Economic Factors	0	-1	+1	+1	0	-1	-1	+1	+2	-1	+2	+2
Archaeological/Historical Factors	0	0	0	0	0	0	0	0	0	0	0	0
Transportation	0	-1	-2	-2	-2	-1	-1	-5	-2	-1	-2	-2
Aesthetics	0	0	-1	-1	-2	0	0	-2	0	-1	+1	+1
Public Health	0	0	-1	-1	-1	0	0	-2	-1	-1	-1	-1
Recreation	0	0	0	0	+1	0	0	-1	0	0	0	0

*Denotes proposed alternative

TABLE 35

QUANTITATIVE COMPARISON OF ALTERNATIVES AND IMPACTS

			Alternatives										
Physical Environment	PIU[1]	Baseline	No-Action	1a[2]	1b	2	3a	3b	4	5	6	7a	7b
Topography	10	0	0	0	0	0	0	0	0	+20	0	+20	+20
Geology	10	0	0	0	0	0	0	0	0	+10	0	+10	+10
Soils	80	0	0	+160	+160	+ 80	0	0	+160	+320	0	+240	+240
Surface Water Quality	60	0	0	- 60	- 60	- 60	0	0	-120	+ 60	0	+ 60	+ 60
Groundwater Quality	70	0	- 70	- 70	- 70	- 70	0	0	-140	+ 70	0	+ 70	+ 70
Air Quality	50	0	- 50	-100	-100	-100	- 50	- 50	-150	-100	- 50	-100	-100
Noise	40	0	0	- 40	- 40	- 80	0	0	-120	- 80	- 40	- 80	- 80
Energy	70	0	- 70	+210	+210	-140	+210	+210	+140	-140	-140	+210	+210
		Subtotal	-190	+100	+100	-370	+160	+160	-230	+160	-230	+430	+430
Ecological Environment													
Aquatic Flora and Fauna	30	0	0	- 30	- 30	- 30	0	0	- 60	+ 30	0	+ 30	+ 30
Terrestrial Flora and Fauna	40	0	0	+ 80	+ 80	+ 40	0	0	+ 80	+120	0	+120	+120
Terrestrial Fauna	40	0	0	- 40	- 40	- 40	0	0	- 40	+ 40	0	+ 40	+ 40
		Subtotal	0	+ 10	+ 10	- 30	0	0	- 20	+190	0	+190	+190
Socioeconomic Factors													
Demography	20	0	0	+ 20	+ 20	+ 20	0	0	+ 20	0	0	0	0
Land Use and Land Use Plans	60	0	- 60	+180	+180	0	0	0	+120	+ 60	0	+ 60	+ 60
Economic Factors	40	0	- 40	+ 40	+ 40	0	- 40	- 40	+ 40	+ 80	- 40	+ 80	+ 80
Archaeological/Historical Factors	60	0	0	0	0	0	0	0	0	0	0	0	0
Transportation	70	0	- 70	-140	-140	-140	- 70	- 70	-350	-140	- 70	-140	-140
Aesthetics	60	0	0	- 60	- 60	-120	0	0	-120	0	- 60	+ 60	+ 60
Public Health	70	0	0	- 70	- 70	- 70	0	0	-140	- 70	- 70	- 70	- 70
Recreation	40	0	0	0	0	+ 40	0	0	- 40	0	0	0	0
		Subtotal	-170	- 30	- 30	-270	-110	-110	-470	- 70	-240	- 10	- 10
		TOTALS	-360	+ 80	+ 80	-670	+ 50	+ 50	-720	+280	-470	+610	+610

[1] Parameter Importance Units
[2] Denotes Proposed Alternative

CHAPTER V

PUBLIC PARTICIPATION AND COORDINATION

COORDINATION WITH GOVERNMENTAL AGENCIES

During the preparation of this draft EIS, contact was made with various public agencies charged with responsibilities for the environment, waste management, public health, agricultural production, soil conservation, and other public concerns related to the project. Among the agencies whose recent, current, or planned activities were monitored in relation to sludge management are:

- Various internal EPA units
- Des Moines ICA Management Agency
- Iowa Department of Environmental Quality
- Polk County Engineering Department
- USDA Soil Conservation Department
- U.S. Food and Drug Administration

Additional coordination was accomplished through communications with U.S. Department of the Interior's Fish and Wildlife Service; Iowa State Historical Department; Division of Historic Preservation; Iowa Geological Survey, U.S. Geological Survey; Polk, Warren, and Marion Planning Departments; and others.

PUBLIC INVOLVEMENT

The Des Moines ICA Agency has attempted to involve and inform the public of the sludge management project through broadcast and print media, public participation and informational meetings, a public hearing, and publication of newsletters. The following highlights these efforts:

- June 23, 1981 - Public Agencies Meeting

  Approximately 100 invitations were issued to representatives of various public agencies to attend this meeting for the purpose of introducing the sludge management EIS process and scoping of issues.

- June 23, 1981 - Public Scoping Meeting

  This public meeting was held for the purpose of introducing the Sludge Management EIS work program and to solicit issues and concerns related to sludge management in the ICA.

- June 24, 1981 - Public Agencies Meeting

  The purpose of this meeting was to define data requirements, identify data sources, and define potential issues related to the project.

- July 29, 1981 - Land Application Public Meeting

  Members of the agricultural community, including Soil Conservation Service, Agricultural Extension, Farm Bureau, County Supervisors, representatives, and farm operators, were invited to tour the Des Moines Main Plant. The purpose of the tour was to show how sludge is processed and familiarize this sector of the public with sludge characteristics. A slide presentation of existing land application programs was also shown.

- August 26, 1981 - Public Hearing for the 201 Study

  The recommendations of the 201 Study were presented and public comment solicited. Solids handling was also discussed.

- October 1, 1981 - Public Information Meeting

  The topics presented included: the EIS methodology selected for use, the solids management alternatives to be considered in this EIS, and the description of the affected environment. Public input was also solicited on these topics and other relevant issues.

- Newsletters

  Bimonthly newsletters entitled "Clean Water Memo" have been directly mailed to elected and public officials, industrial representatives, members of CIRALG's Technical Committee and Policy Committee members, the ICA agency's Citizens Advisory Committee, local media, public agencies, and private interested citizens. The distribution list presently contains approximately 600 names. Four of the five newsletters to date have addressed various topics related to sludge management.

Despite concerted efforts to solicit public opinion and input, little public reaction and few issues have been raised. Public reaction to the land application program proposed in the 201 Study has been favorable. Most of this has been expressed by area farm operators familiar with the project who are interested in utilizing the sludge. It is presumed that significant reaction to the project has not materialized due to the fact that specific sites for sludge disposal have not yet been identified or selected. Another factor which may have a bearing on this lack of reaction is the general citizenry's familiarity with agricultural practices in the area which include the application of substantial quantities of inorganic fertilizers, herbicides, pesticides, and manure on cropland.

To date, four issues have been raised, all by the Director of Polk County's Physical Planning Department. These are listed below:

1. The apparent predetermined conclusions that land application of the sludge is the most desirable alternative
2. The problem of contamination of stormwater runoff and air pollution due to land application, especially the stockpiling of sludge
3. The problem of heavy metal buildup in agricultural land due to extensive or extended application sludge
4. The impact on the county road system due to increased truckloads and/or spillage

These are addressed in the "Environmental Consequences" Chapter. No revisions of the proposed project were made since measures to mitigate these concerns are presently incorporated in the project proposal.

LIST OF PREPARERS

Name	Organization	Disciplinary Area	Years Experience
Boblitt, G. T. M.S., Environmental Engineering	TenEch	Water Quality, Transportation	9
Braswell, J. W. M.S., Environmental Engineering	ES	Sludge Management Alternatives, Site Investigations, Energy, Groundwater	6
Fralish, S. H. B.S., Environmental Engineering	TenEch	Noise, Public Health	7
Gibbons, G. M. M.S., Environmental Engineering	ES	Sludge Management Alternatives, Site Investigations, Geology, Topography, Soils	4
Grauvogel, L. W. M.S., Environmental Engineering	TenEch	Public Health, Air Quality	9
Harris, J. M. B.A., Biology	ES	Ecology	7
Kay, G. G. M.S., Aquatic Biology	TenEch	Public Health and Review	8
Palombo, D. A. M.S., Geohydrology	ES	Geology, Groundwater	7
Pavoni, J. L. Ph.D., Environmental Engineering	TenEch	Environmental Review	12
Shea, T. G. Ph.D., Environmental Engineering	ES	Sludge Management Alternatives, Environmental Review	15
Strobridge, D. E. B.S., Environmental Sciences	TenEch	Socioeconomics, Transportation, Site Investigations, Recreation	7
Turner, H. J. M.S. Environmental Engineering	ES	Land Application of Sludge	8

NOTE: TenEch - TenEch Environmental Engineers, Inc.
ES - Engineering-Science, Inc.

REFERENCES

Anderson, Adrian D., State Historic Preservation Officer, Iowa State Historical Department, Division of Historic Preservation, personal communication, 1981.

Bernenson, Abram, ed., Control of Communicable Disease in Man, American Public Health Association, Washington, D.C., 11th Edition, 1970.

Bureau of the Census, "1970 Census of Population."

Bureau of the Census, "1970 Census of Population and Housing Characterization."

Bureau of the Census, "1978 Census of Agriculture," Volume 1, State and County Data, U.S. Government Printing Office, Washington, D.C., April, 1981.

Bureau of the Census, "1980 Census of Population and Housing (Advance Report)."

Burge, W. D., and P. B. Marsh, "Infectious Disease Hazards of Landspreading Sewage Wastes," Journal of Environmental Quality, Volume 7, January-March, 1978.

Cagle, J. W., and A. J. Heinty, "Iowa Geological Survey Water Atlas Number 5, Water Resources of South-Central Iowa, State of Iowa," Iowa City, Iowa, 1978.

Central Iowa Regional Association of Local Governments (CIRALG), "Preliminary Revised Population Projections for the Des Moines 208 Planning Area."

Central Iowa Regional Association of Local Governments (CIRALG), Developed by Real Estate Research, 1974.

Central Iowa Regional Association of Local Governments (CIRALG), personal communication, September, 1981.

Chaney, Rufus L., "Land Application of Sewage Sludge: Benefits and Problems," Proceedings of the 1973 Lime and Fertilizer Conference, 5:15-23, 1973.

Cookson, Dr. J. T., JTC Environmental Consultants, Bethesda, Maryland, personal communication, November 18, 1981.

Council on Environmental Quality in Association with the U.S. Environmental Protection Agency, "Evaluation of Municipal Sewage Treatment Alternatives," February, 1974.

"County Business Patterns - Iowa, 1979."

Culp, Jone, Labor Analyst, Job Service of Iowa, personal communication, September 15, 1981.

Currier, Dr. Russell, Chief, Division of Disease Prevention, Iowa State Department of Public Health, personal communication, November 10, 1981.

Des Moines ICA Existing Solids Handling Data, personal communication with City Officials and/or Wastewater Treatment Plant Operators.

Donahue/Metcalf and Eddy, Draft Des Moines 201 Facility Plan, 1981.

Dotson, G. K., "Constraints to Spreading Sewage Sludge on Cropland," from "News of Environmental Research in Cincinnati," U.S. Environmental Protection Agency, May 31, 1973.

Durham, Mick, Iowa Department of Environmental Quality, personal communication, November 18, 1981.

"Effects of Heavy Metals in Sludge on Agricultural Crops," Journal of the Water Pollution Control Federation, Volume 51, No. 10, October, 1979.

Epstein, E., "Effect of Sewage Sludge on Some Soil Physical Properties," Journal of Environmental Quality, 4(1), 1975.

Epstein, E., J. M. Taylor, and R. L. Chaney, "Effects of Sewage Sludge and Sludge Compost Applied to Soil on Some Soil Physical and Chemical Properties," Journal of Environmental Quality, 5:4, 1976.

Gradwohl, David M., "Archaeological Salvage Investigations," Research Report, Iowa State University Archaeological Laboratory, Ames, Iowa, October, 1973.

Gradwohl, David M., "Archaeology of the Central Des Moines River Valley: A Preliminary Survey," Aspects of Upper Great Lakes Anthropology, Minnesota Historical Society, St. Paul, Minnesota, 1974.

Harlan, J. R., and E. B. Speaker, Iowa Fish and Fishing, 4th Edition, State of Iowa, Des Moines, Iowa, 1969.

Harrington, Dale S., Assistant Polk County Engineer, personal communication (provided excerpts from "Polk County Secondary Road Department Bridge Inspection Summary"), October 20, 1981.

Herceg, Kenneth P., P.E., City Engineer, Oberlin, Ohio, personal communication, January, 1980.

"Industrial Wastes Pretreatment and EPA Cadmium Limitations," Journal of the Water Pollution Control Federation, Volume 52, No. 10, October, 1980.

Iowa Conservation Commission, Planning and Coordination Section, Outdoor Recreation in Iowa, Volumes I through V(a), Second Revision, July, 1972.

Iowa Department of Environmental Quality, IDEQ Rules, Title IV, Solid Waste Disposal Act, Chapter 29, November 21, 1979.

Iowa Department of Environmental Quality, IDEQ Rules, Title IV, Solid Waste Disposal Act, Chapter 33, November 21, 1979.

Iowa Department of Transportation, Office of Transportation Inventory, Planning, and Research Division, "1980 Volume of Traffic on the Primary Road System of Iowa."

Iowa Geological Survey, Geological Map of Iowa, 1969.

Iowa Office of Program Planning, 1977.

Iowa State Historical Department, Division of State Preservation, personal communication, July 24, 1981.

Johnson, Mark, Air Planning Section, Iowa Department of Environmental Quality, personal communication, July 20, 1981.

Kennedy, J. O., and R. C. Splinter, "Water Quality Survey, Selected Tributaries, Lower Des Moines River, August and September, 1980," No. 81-83, University of Iowa Hygenic Laboratory, University of Iowa, Iowa City, Iowa.

McKusick, M., and J. Ries, Archaeological Survey of Red Rock Reservoir, Iowa, State University of Iowa, January, 1962.

"Metal Accumulation and Crop Yield . . . with Sewage Sludge," Engineering Science and Technology, Volume 15, No. 7, July, 1981.

Millner, P. D., et al, "Occurrence of Aspergillus fumigatus during Composting Sewage Sludge," Journal of Applied Environmental Microbiology, Volume 34:6, pp. 765-772, 1977.

Nash, Tom, Fish and Wildlife Service, U.S. Department of the Interior, personal communication, July 17, 1981.

National Oceanic and Atmospheric Administration, "Local Climatological Data, Annual Summary with Comparative Data, 1980, Des Moines, Iowa."

PEDCo Environmental, Inc., Technical Assistance to the Des Moines Metropolitan Area Solid Waste Agency, Final Report, June, 1980.

Prior, J. C., "A Regional Guide to Iowa Landforms, Iowa Geological Survey Educational Series 3," Iowa Geological Survey, Iowa City, Iowa, 1976.

Snyder, Paul, Iowa Department of Agriculture, personal communication, September 15, 1981.

Soil Conservation Service, U.S. Department of Agriculture, Soil Survey of Polk County, Iowa, Washington, D.C., June, 1960.

Soil Conservation Service, U.S. Department of Agriculture, Soil Survey of Warren County, Iowa, Washington, D.C., August, 1978.

State Conservation Commission, Endangered and Threatened Iowa Vascular Plants, August, 1979.

State Conservation Commission, Endangered Iowa Vertebrates, 1977.

U.S. Army Corps of Engineers, Final Environmental Impact Statement, Operation and Maintenance, Red Rock Dam and Lake Red Rock, August, 1975.

U.S. Department of Energy, Operational Characteristics of Anaerobic Digesters at Selected Municipal Wastewater Treatment Facilities in the United States, PNL-2815.

U.S. Department of the Interior, U.S. Fish and Wildlife Service, personal communication, July 17, 1981.

U.S. Environmental Protection Agency, "Application of Sewage Sludge to Cropland," EPA 430/9-76-013, November, 1976.

U.S. Environmental Protection Agency, Compilation of Air Pollutant Emission Factors, Parts A and B, 3rd Edition, EPA AP-42, August, 1977.

U.S. Environmental Protection Agency, "Energy Conservation in Municipal Wastewater Treatment," EPA 430/9-77-011.

U.S. Environmental Protection Agency, Final Environmental Impact Statement Metro Denver Sewage Sludge Management Plan, Volume 1, EPA 908/5-78-001A, February, 1978.

U.S. Environmental Protection Agency, Levels Document, 1976.

U.S. Environmental Protection Agency, Supplement No. 5 for Compilation of Air Pollutant Emission Factors, 2nd Edition, Research Triangle Park, North Carolina, 1975.

U.S. Environmental Protection Agency, "Technical Bulletin - Municipal Sludge Management Environmental Factors," Preliminary Draft, EPA 430/0-75-xxx, July, 1975.

U.S. Environmental Protection Agency, and Kirkham, Michael Consortium, Final Environmental Impact Statement for Des Moines 208 Areawide Waste Treatment Management Plan, U.S. Environmental Protection Agency, Region VII, Kansas City, Missouri, July, 1977.

Veenstra and Kim, "Land Use Plan and Policies, Warren County, Iowa, 1979."

APPENDIX A

ENVIRONMENTAL SETTING OF REPRESENTATIVE LAND APPLICATION AND SLUDGE DISPOSAL SITES

APPENDIX A

ENVIRONMENTAL SETTING OF REPRESENTATIVE LAND APPLICATION AND SLUDGE DISPOSAL SITES

Detailed site visits were made to three farms in the vicinity of Des Moines ICA, to the Des Moines Metro East Landfill, and to an abandoned strip mine in Marion County. The three farms (Sites 1, 2, and 3) had been identified by the 201 consultant as representative of conditions within the two areas determined to have the greatest potential for land application. Selection was based on interest expressed by the land owners in the utilization of sludge for land application on their farms. Site 4 was the Des Moines East Landfill where sludge from the Des Moines Main Wastewater Treatment Plant is now being disposed. Site 5 was an abandoned strip mine east of Knoxville in Marion County which was selected as representative of abandoned mine land in Marion County. Locations of Sites 1, 2, and 3 relative to the Des Moines Main Plant are shown in Figure A-1.

SITE 1 - POLK COUNTY LAND APPLICATION SITE

The representative land application site in Polk County is located about 5 miles southeast of the Des Moines Main Wastewater Treatment Plant. As indicated in Figure A-2, the site is at the intersection of SE 64th Avenue and SE 45th Street (State Highway 5). The site consists of 3 rectangular areas of land with areas of 240, 16, and 40 acres. There are approximately 15 residences adjacent to the site, and a new regional mall (South Ridge Mall) is approximately 4 miles from the site.

Crops are divided approximately equally between corn and soybeans (approximately 100 acres each) which are rotated yearly. Additionally, some alfalfa and wheat are grown (28 and 12 acres, respectively). The remainder of the site is pasture, on which 25 to 30 head of beef cattle are raised, and the residence of the site's owner.

Topography

The topography of the site is moderately rolling slopes. A ridge line which runs east-west through the center of the 240-acre area is at an elevation of 890 to 900 feet above sea level, and a drainage valley in the northern portion of this area drops to an elevation of 850 feet above sea level. The smaller area slopes from a high point of 870 feet above sea level at the northwest corner of the 40-acre area to a low point of 800 feet above sea level at its southwest corner.

Soils

The soil at the site is primarily Sharpsburg silt loam, with a small outcropping of Nodaway silt loam adjacent to the drainage valley (SCS, 1960). The depth of the surface layer of this soil is commonly 6 to 9 inches, with the underlying loess 8 to 10 feet thick. Drainage is good, and the subsoil has moderate permeability. Drainage tiles have

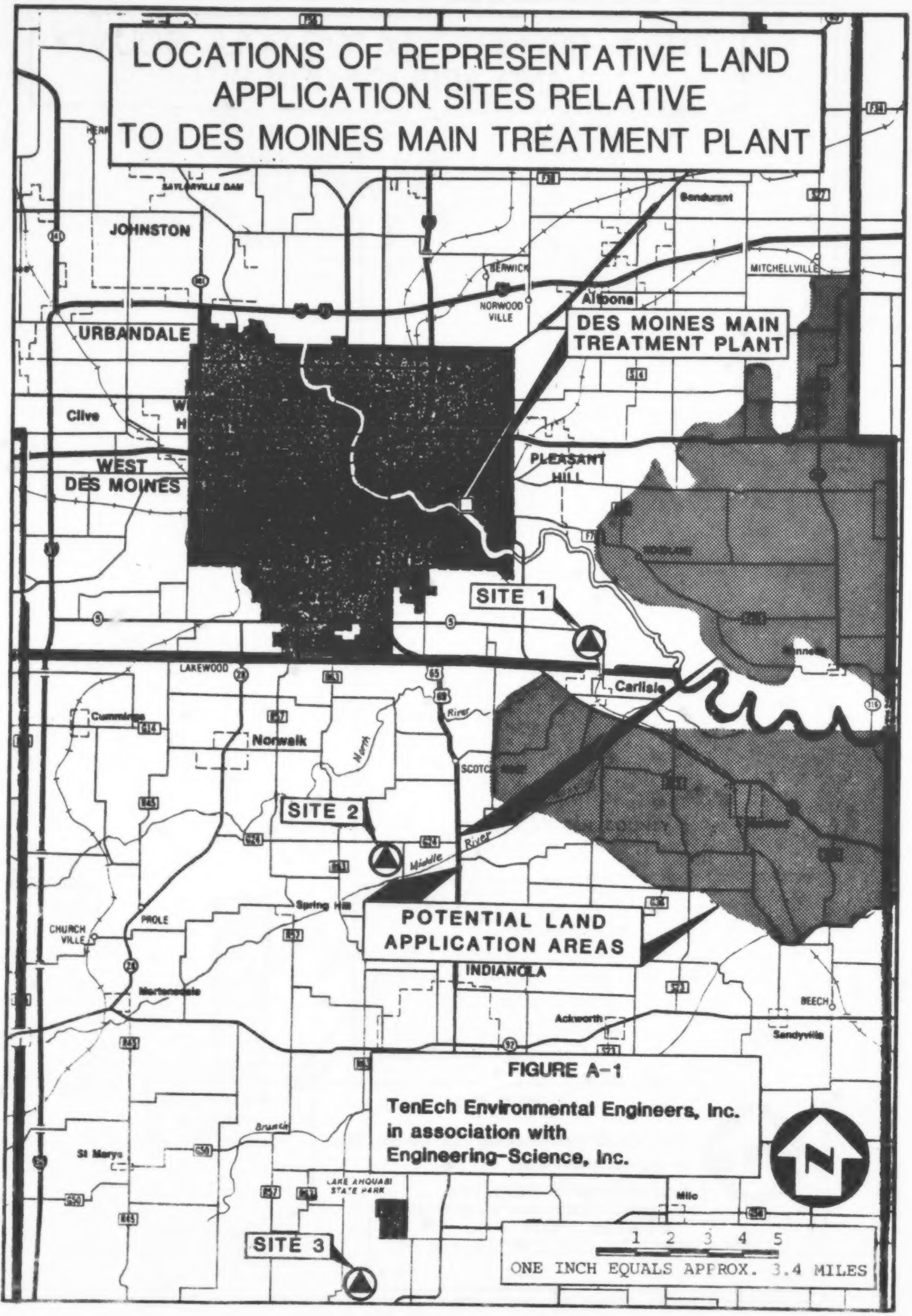
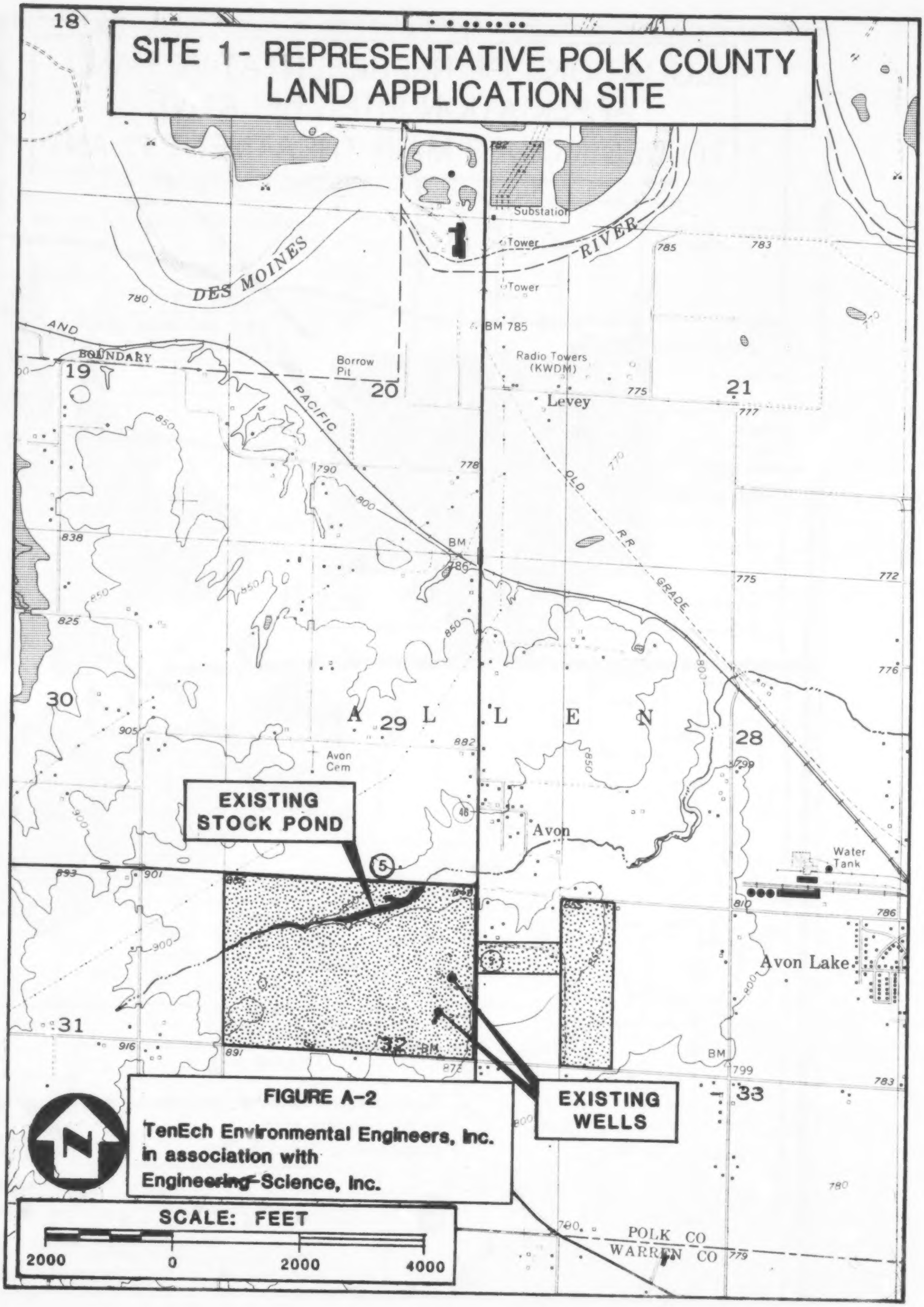

LOCATIONS OF REPRESENTATIVE LAND APPLICATION SITES RELATIVE TO DES MOINES MAIN TREATMENT PLANT
SAYLORVILLE DAM
JOHNSTON
Bondurant
BERWICK
MITCHELLVILLE
NORWOOD VILLE
Altoona
DES MOINES MAIN TREATMENT PLANT
URBANDALE
Clive
WEST DES MOINES
PLEASANT HILL
SITE 1
LAKEWOOD
Carlisle
Cummings
Norwalk
North River
SCOTCH
SITE 2
Middle River
Spring Hill
PROLE
CHURCH VILLE
POTENTIAL LAND APPLICATION AREAS
INDIANOLA
Martensdale
Ackworth
BEECH
Sandyville
St Marys
Branch
LAKE AHQUABI STATE PARK
Milo
SITE 3
N
1 2 3 4 5
ONE INCH EQUALS APPROX. 3.4 MILES

FIGURE A-1

TenEch Environmental Engineers, Inc.
in association with
Engineering-Science, Inc.



SITE 1- REPRESENTATIVE POLK COUNTY LAND APPLICATION SITE

FIGURE A-2

TenEch Environmental Engineers, Inc. in association with ~~Engineering~~-Science, Inc.

EXISTING STOCK POND
EXISTING WELLS
SCALE: FEET
2000
0
2000
4000
DES MOINES
RIVER
Substation
Tower
Tower
BM 785
Radio Towers (KWDM)
Borrow Pit
Levey
AND
BOUNDARY
PACIFIC
OLD RR GRADE
ALLEN
Avon Cem
Avon
Avon Lake
Water Tank
POLK CO
WARREN CO
18
19
20
21
28
29
30
31
32
33
780
785
783
775
777
778
790
800
850
838
825
905
882
786
772
776
799
810
893
901
900
916
891
873
783
780
779
BM

been installed within the drainage valley to improve drainage. Soils capability is Subclass III e, indicating moderate erosion hazard.

Surface Water

There is a small stream in the drainage valley of the 240-acre area which has been dammed to form a stock pond in the northeast corner of this area. Stream flow is slight to intermittent.

Groundwater

There are two wells on the site, both near the eastern boundary of the 240-acre plot. One well, located in the surficial aquifer, has a depth of 25 to 30 feet; and the normal water level is at a depth of 10 to 15 feet. However, in some springs, the water level rises to ground level. Water quality is good. The other well has a depth of 400 feet, and normal water level is 100 feet. Water from this lower aquifer has a high mineral content and is of low quality.

Biology

All but 20 acres (adjacent to the drainage valley) of the site are under cultivation or used for pastureland. Corn and soybeans are rotated annually on the cultivated part of the site. There is light natural vegetation along the banks of the intermittent stream leading to the stock pond. Existing wildlife habitat is limited to the 20 acres adjacent to the drainage valley.

Other

Air quality in the vicinity of the site is good; noise is minimal; and there are no noticeable odors.

Fertilizer is now being applied on a biannual basis to the acreage being planted in corn. No fertilizer is applied to the acreage planted in soybeans.

SITE 2 - PRIMARY WARREN COUNTY LAND APPLICATION SITE

The representative land application site in Warren County is located about 16 miles southwest of the Des Moines Main Wastewater Treatment Plant. The site is 2-1/2 miles west of Highway 65-69, with its northern boundary County Highway G-24 and its southern boundary the Middle River (Figure A-3). The site is an irregular rectangle with an area of approximately 400 acres. The site, which is 3 miles west of the Banner Mine State Wildlife Management Area, has less than 10 residences adjacent to the site.

The site is planted almost entirely in corn (approximately 320 acres), with the area adjacent to County Road G-24 utilized for raising hogs. Storage buildings, silos, and the residence of the owner are also located along County Road G-24.

Topography

The topography of the site can be separated into two distinct sections. The section adjacent to County Road G-24 and comprising approximately 35 percent of the site has a moderate slope of about 10 percent, with the high point along G-24 at 920 feet above mean sea level and sloping southward to an elevation of 810 feet above mean sea level. The lower section of the site which is adjacent to the Middle River is flat and is within the river's floodplain.

Soils

The soil in the upper section of the site is primarily Sharpsburg silty clay loam. The depth of the surface layer is about 16 inches thick, and the silty clay loam subsoil extends to a depth of 50 inches. The soil is well drained, and permeability is moderately slow. Soils capability is Subclass III e-1, indicating moderate erosion hazard. The soil in the lower section of the site consists of Zook and Wabash silty clay loam and Wabash silty clay. These soils, which are characteristically found in bottomlands, have a surface layer depth of about 36 inches; and the subsoil extends to a depth of 52 inches. All of these soils are very poorly drained, and permeability is very slow (SCS, 1978). Soils capability is III e-3, indicating significant drainage problems which limit use.

Surface Water

There is a small stock pond in the northeast corner of the site and an intermittent stream which flows across the site and discharges into the Middle River. As indicated, the Middle River forms the southern boundary of the site, and its floodplain covers the lower section of the site (elevation 810 feet above sea level).

Groundwater

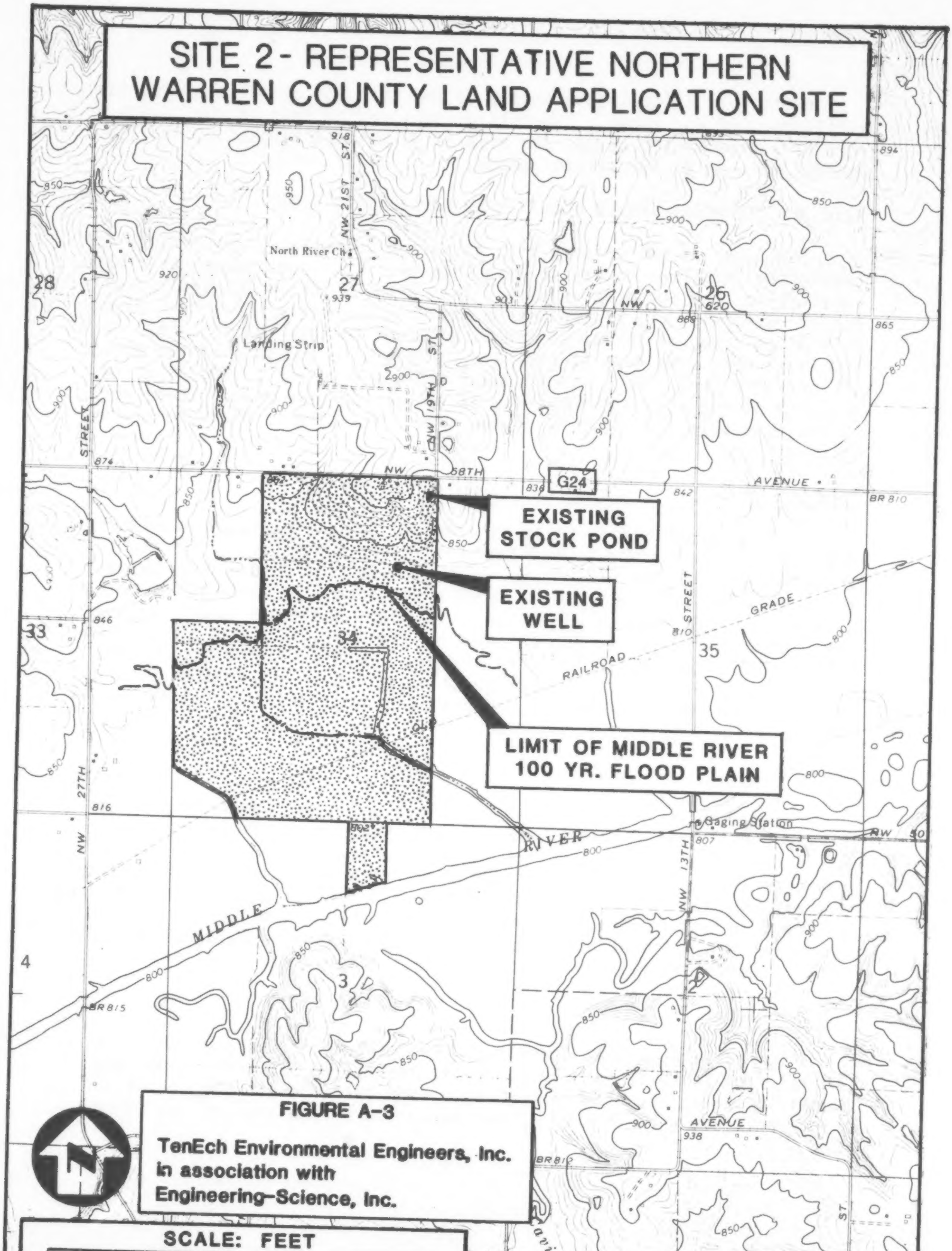
There are two wells on the site, one adjacent to Highway G-24 at a depth of 30 feet and the second at the bottom of the upper section of the site at a depth of 45 feet. The groundwater level in the lower section of the site tends to be high, rising to ground level in the winter and spring.

Biology

Essentially, the whole site is utilized for either growing corn, raising hogs, or building. Natural habitat is limited to the area adjacent to the stock pond and the banks of the Middle River. No small game was observed.

Other

Air quality in the vicinity of the site is good, and noise is minimal. As a result of the raising of hogs, a significant odor is present in the section of the site adjacent to County Road G-24.



SITE 2 - REPRESENTATIVE NORTHERN WARREN COUNTY LAND APPLICATION SITE

EXISTING STOCK POND
EXISTING WELL
LIMIT OF MIDDLE RIVER 100 YR. FLOOD PLAIN
SCALE: FEET
2000
0
2000
4000
N
North River Ch
Landing Strip
NW 21ST ST
NW 19TH ST
NW 27TH STREET
NW 13TH STREET
NW 9TH ST
NW 58TH AVENUE
G24
RAILROAD GRADE
MIDDLE RIVER
Gaging Station
AVENUE
28
27
26
33
34
35
4
3
2
850
900
800

FIGURE A-3

TenEch Environmental Engineers, Inc. in association with Engineering-Science, Inc.

Fertilizer is applied annually to the site and consists of inorganic fertilizer and hog manure. Fertilizer application rate is 200 pounds per acre of nitrogen, 100 pounds per acre of 48 percent potassium, and 100 pounds per acre of 60 percent potash.

SITE 3 - SECONDARY WARREN COUNTY LAND APPLICATION SITE

The owner of the primary site in Warren County also was leasing another farm in Warren County so this site was also investigated as a representative land application site. This site, which is located approximately 30 miles south of the Des Moines Main Wastewater Treatment Plant, is 9 miles south of Indianola and is adjacent to Lake Ahquabi State Park and the Hooper Game Area (Figure A-4). This site consists of two areas of land on either side of County Road R-57, with areas of 200 acres to the west of the road and 500 acres to the east of the road. There were no residences in the vicinity of the site. The site is planted entirely in corn.

Topography

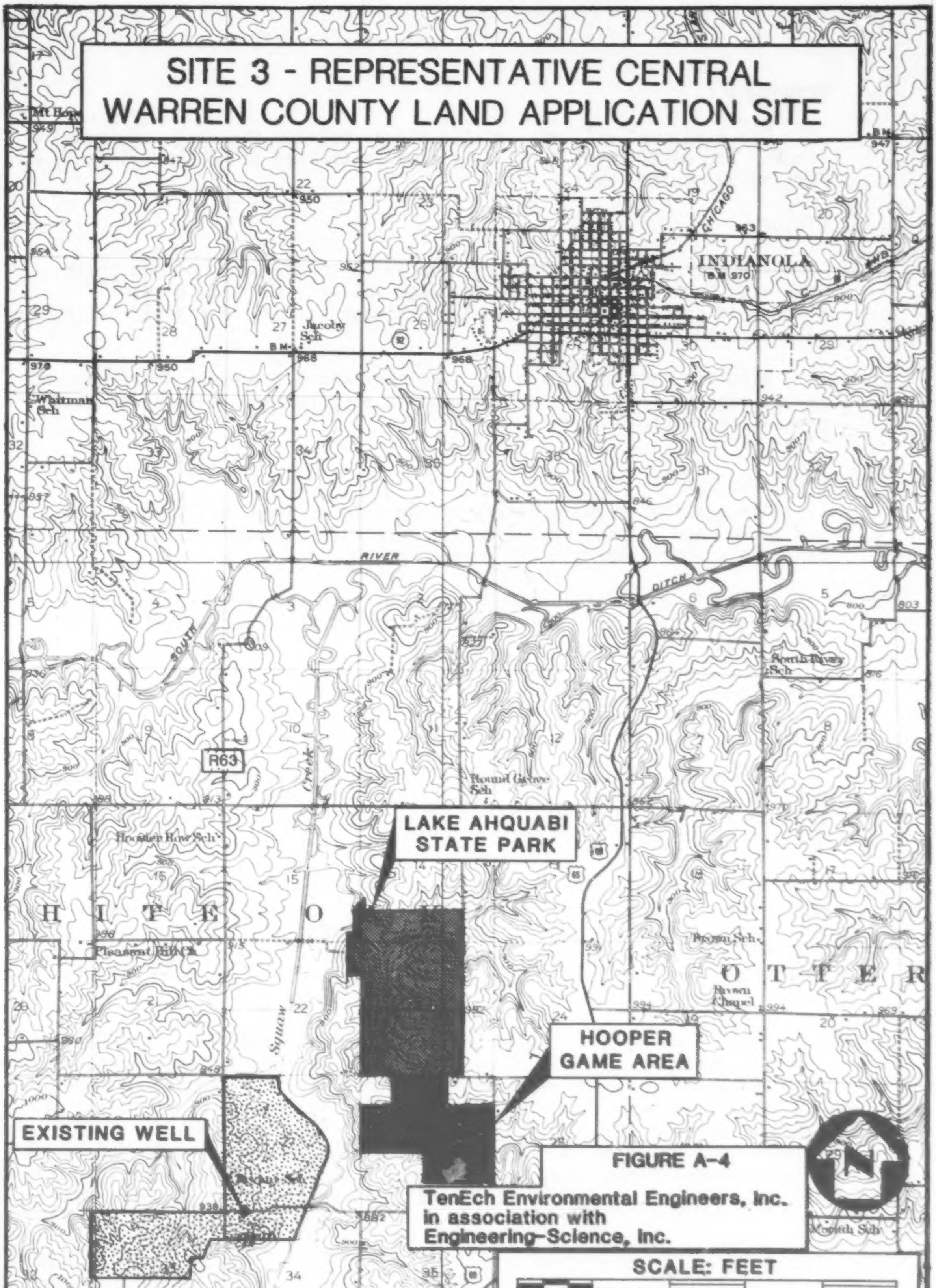
The topography of the site is moderate to severely rolling slopes. A ridge line runs along County Road R-57 at an elevation of 975 feet above sea level. The area to the east of this road slopes down through three drainage valleys to Squaw Creek which forms the eastern boundary of the site and is at an elevation of 900 feet above sea level. Slopes vary between 9 to 14 percent adjacent to the road and 0 to 2 percent adjacent to the creek. To the east of County Road R-57, the site slopes through a single drainage valley to an elevation of 900 feet above sea level. Slopes are 5 to 14 percent away from this drainage valley and 14 to 25 percent within this valley.

Soils

The soils at the site consist of Gara and Armstrong loams; Ladoga, Ackmore, and Gosport silty loams; Wabash, Sharpsburg, Macksburg, and Nevin silty clay loams; and Zook and Colo silty clays. All the soils are characterized as having moderate to poor drainage and slow permeability. The site is moderately eroded along the drainage valleys. Along the land adjacent to Squaw Creek, drainage tiles have been installed to improve drainage; and sediment basins are installed in the drainage valleys (SCS, 1978). Soils capability varies from Class I to Subclass III e-1.

Surface Water

As indicated, Squaw Creek forms the eastern boundary of the site. Normal flow is relatively low; however, debris in the trees along the banks indicates the creek experiences high peak flows. Because of the high banks and wide channel, flows appear to be confined to the stream bed.



SITE 3 - REPRESENTATIVE CENTRAL WARREN COUNTY LAND APPLICATION SITE

LAKE AHQUABI STATE PARK
HOOPER GAME AREA
EXISTING WELL
INDIANOLA
SOUTH RIVER
DITCH
Squaw Creek
R63
SCALE: FEET
3000
0
3000
6000
9000
12000
N

FIGURE A-4

TenEch Environmental Engineers, Inc.
in association with
Engineering-Science, Inc.

Groundwater

One abandoned well was located midway between the road and Squaw Creek. The water level in this well was estimated to be approximately 20 feet below ground level.

Biology

The entire site has been cultivated up to the banks of the creek; and, with the exception of the drainage valleys, the entire site is planted in corn. Vegetation in the drainage valleys is limited to grasses of less than 1 foot in height.

Wildlife habitat within the site is limited; however, there were numerous raccoon tracks in the sediment in the drainage valleys; and two pheasant were sighted.

Other

Air quality in the vicinity of the site is good; noise is minimal; and there were no noticeable odors. Fertilizer is applied at the same rates as at the other site in Warren County.

There is a private cemetery adjacent to County Road R-57 at the south end of the site. This cemetery appears to be approximately 120 years old.

SITE 4 - DES MOINES LANDFILL

Landfill

Currently, sludge is landfilled at the Des Moines Metropolitan Area Solid Waste Agency Metro Park East Landfill. This has been done since the site opened in 1972. Before the landfill opened, sludge had been landfilled at the old site which Metro Park East replaced.

The Des Moines Metropolitan Solid Waste Agency (DMMSWA) was formed in December of 1969 to coordinate solid waste disposal activities of the surrounding communities. The Agency is composed of sixteen equal voting members, fifteen communities, and Polk County. The Agency purchased the Metro Park East Landfill site in 1972 and the Metro Park West site in 1976. Locations of these facilities are provided in Figure A-5.

Metro Park East is the Agency's only active landfill. The 400-acre site is located roughly 10 miles east of the Des Moines city limits on State Route 163 (Figure A-6). An additional 123-acre adjoining property was later acquired; and, although currently not permitted, it is anticipated it will be approved for landfilling by the zoning board. The remaining life of Metro Park East is approximately 6 years, with the adjoining property providing an additional 3 to 4 years. The total remaining life of Metro Park East is thus 9 to 10 years. Upon closure, the

DES MOINES METROPOLITAN AREA SOLID WASTE AGENCY LANDFILL SITES

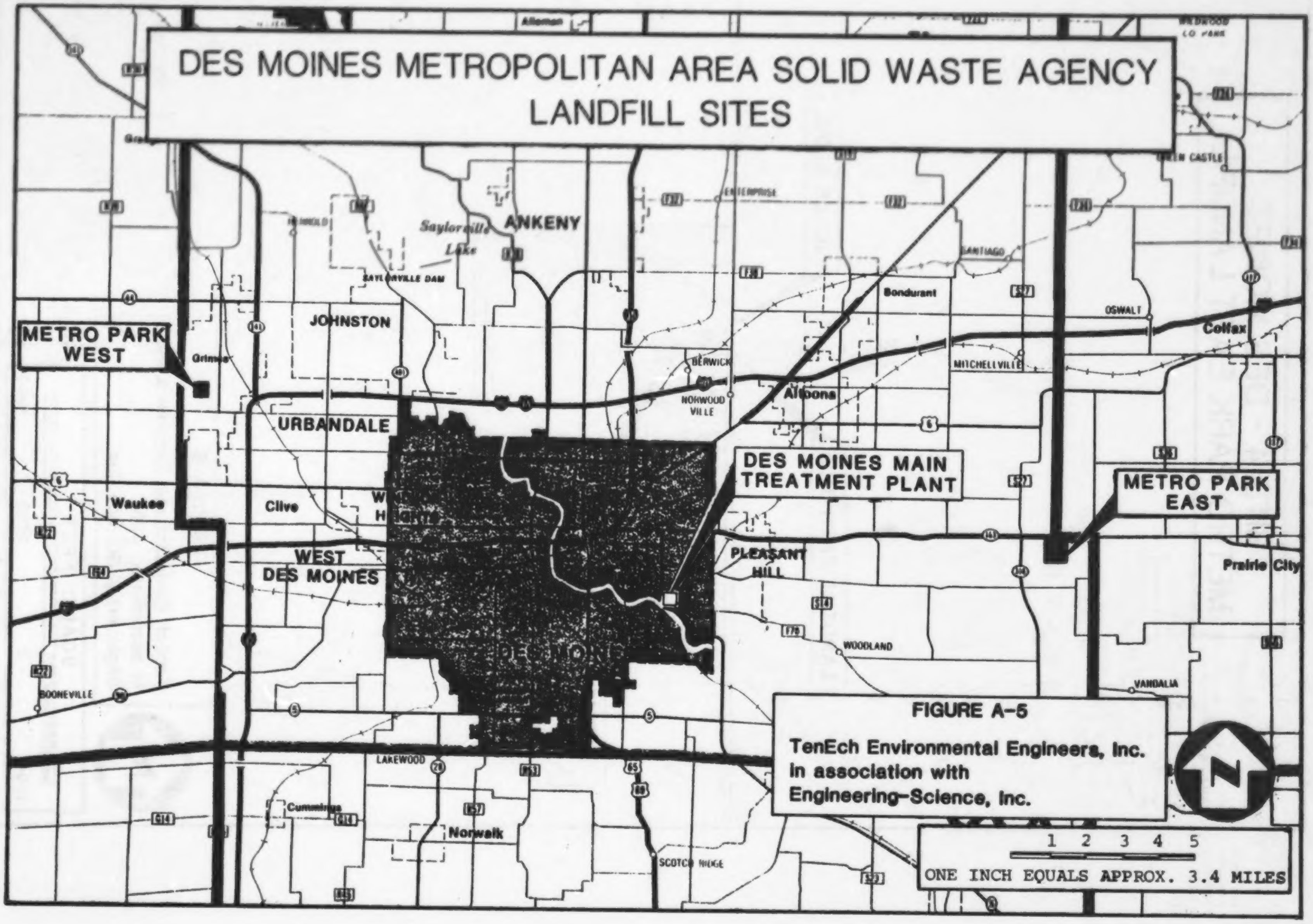
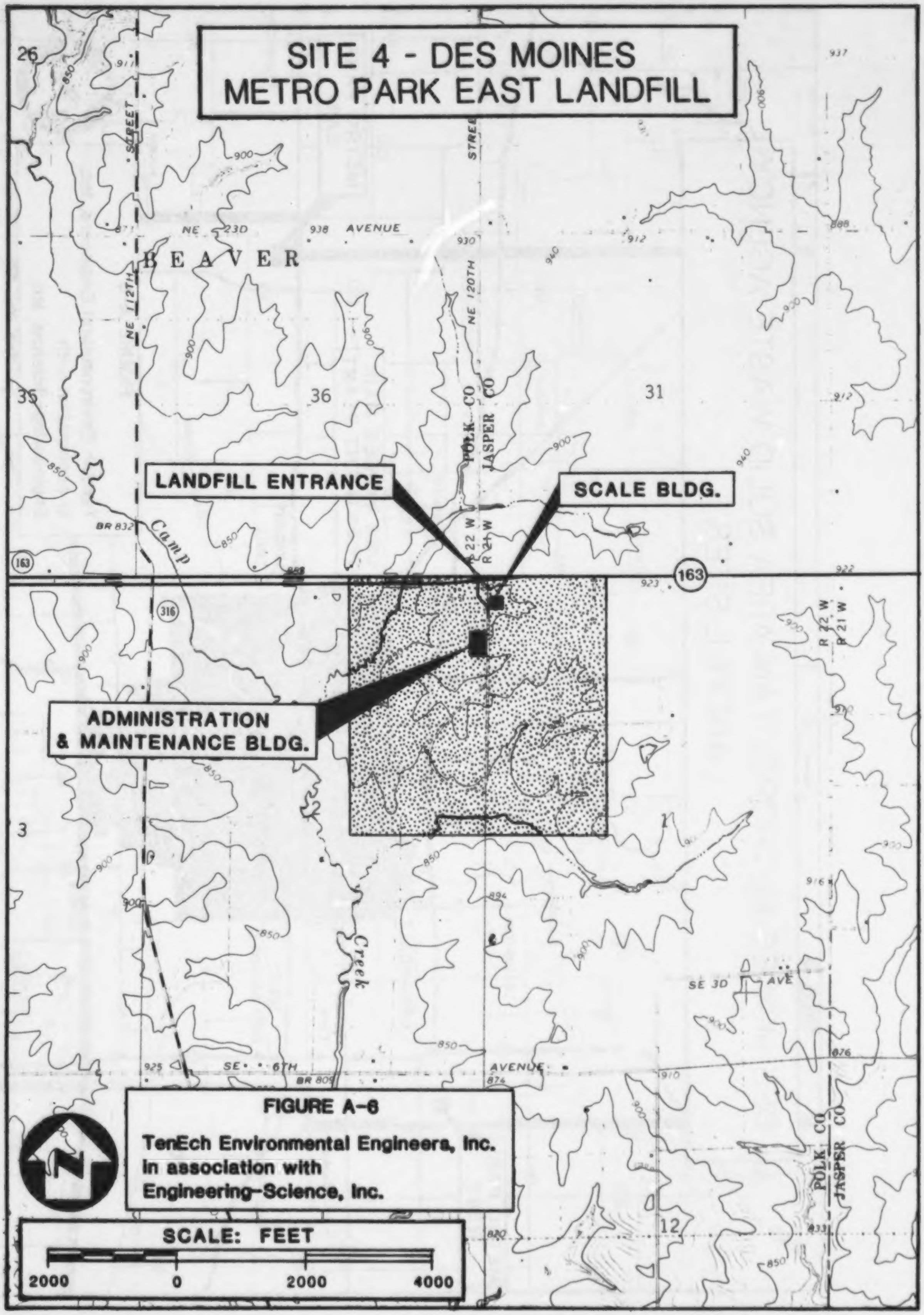

METRO PARK WEST
DES MOINES MAIN TREATMENT PLANT
METRO PARK EAST
ANKENY
Saylorville Lake
SAYLORVILLE DAM
JOHNSTON
URBANDALE
Grimes
Waukee
Clive
WEST DES MOINES
DES MOINES
PLEASANT HILL
Altoona
Bondurant
BERWICK
NORWOOD VILLE
ENTERPRISE
SANTIAGO
MITCHELLVILLE
OSWALT
Colfax
Prairie City
VANDALIA
WOODLAND
LAKEWOOD
Norwalk
Cummings
SCOTCH RIDGE
BOONEVILLE
Alleman
GREEN CASTLE
N
1 2 3 4 5
ONE INCH EQUALS APPROX. 3.4 MILES

FIGURE A-5

TenEch Environmental Engineers, Inc.
in association with
Engineering-Science, Inc.



SITE 4 - DES MOINES METRO PARK EAST LANDFILL

FIGURE A-6

TenEch Environmental Engineers, Inc.
in association with
Engineering-Science, Inc.

LANDFILL ENTRANCE
SCALE BLDG.
ADMINISTRATION & MAINTENANCE BLDG.
SCALE: FEET
2000
0
2000
4000
BEAVER
Camp
Creek
NE 23D
AVENUE
NE 112TH STREET
NE 120TH STREET
POLK CO
JASPER CO
R 22 W
R 21 W
SE 3D AVE
SE 6TH AVENUE
BR 832
BR 809
163
316
26
35
36
31
3
1
12
900
850
938
930
912
940
937
888
922
923
910
916
876
874
894
925
833
820

Polk County Conservation Commission plans to turn the site into a winter recreation area.

Soil Conservation Service maps show the predominate soil is Tama silt loam of capability of Class III e. Slopes vary from 5 to 14 percent, with drainage generally good and moderate erosion. Tama silt loams are moderately permeable. The Metro Park East site has had no leachate problems, although there is no collection system. Thirteen groundwater monitoring wells located on the site are checked twice a year (April and September) and have never indicated any substantial water quality deterioration. Groundwater depth in the site is estimated at 20 to 30 feet.

The area surrounding Metro Park East is primarily agricultural land used for growing corn and soybeans. A Technical Assistance Report to the Agency by PEDCo Environmental, Inc. of June, 1980, notes the citizens in the area are generally satisfied with the operation of the landfill (PEDCo, 1980). Sludge transportation from the Des Moines Main Plant to the site goes north over State Route 46 and then east along Route 163. These are both classified as major highways, with Route 163 being a 4-lane divided highway between the city limits and the landfill. The haul distance is 12.8 miles, with roughly 3.5 miles inside the city. The remaining 9.3 miles are on Route 163 outside the city limits. Trucks have been hauling sludge along this route for 9 years since the landfill opened.

A second landfill site, Metro Park West, was acquired in 1976 to provide disposal areas on both sides of the city. The site encompasses 160 acres, approximately 5.5 miles west-northwest of the Des Moines city limits in Grimes. Metro Park West has, as yet, not been developed.

The Board of Adjustment of Polk County has given the site an 8-year operation limit from June of 1980 to June of 1988. The site was originally permitted by the Iowa Department of Environmental Quality (IDEQ); however, this has not been renewed by the Agency. Regulations regarding landfills have changed considerably since then. The PEDCo report states IDEQ is of the opinion that "hydrogeologic conditions are unlikely to result in acceptance of the site without extensive engineering and operating modifications." The PEDCo report, however, also notes the consulting engineering firm of Shive-Haltery reviewed the suitability of the site; and, in their report of November 5, 1979, concluded that "it is expected that the site will comply with present IDEQ standards" (PEDCo, 1980).

Borings of the site were taken in 1972. Soils are generally of the Nicollet-Webster series of capability Class I. Slopes in the area vary from 1 to 3 percent, with intermediate drainage. Soils show only minor erosion. Permeability of Nicollet-Webster soils is moderate. The groundwater in the area is high, with depths to the water table only 1-1/2 to 3 feet in the spring and during periods of heavy rain.

The area surrounding the site and the actual site itself is primarily farmland. Access to the site is from 54th Street. Presently, only a gravel road leads to the landfill. If activated, this would require paving.

The 1988 operational limit, anticipated permit renewal difficulty, and general construction costs make the activation of the Metro Park West site uncertain. It remains a valuable property for sale or trade by the Agency.

Metro Park East is the active landfill operated by the Des Moines Metropolitan Area Solid Waste Agency. Operational costs are more than offset by gate receipts, with the excess profit being invested. Tipping fees vary with the type of waste. The landfill accepts almost all wastes which are not classified as hazardous, along with some small generator hazardous wastes permitted by the IDEQ. Permits are also required for all industrial and municipal sludges under the IDEQ special wastes program. Sludges must also continually pass EPA toxicity tests. Yearly volume of waste landfilled is slightly less than 300,000 tons (271,234 in 1980; 297,804 in 1979) or 24,000 tons per month. Monthly average for 1981 through August is 23,870 tons per month.

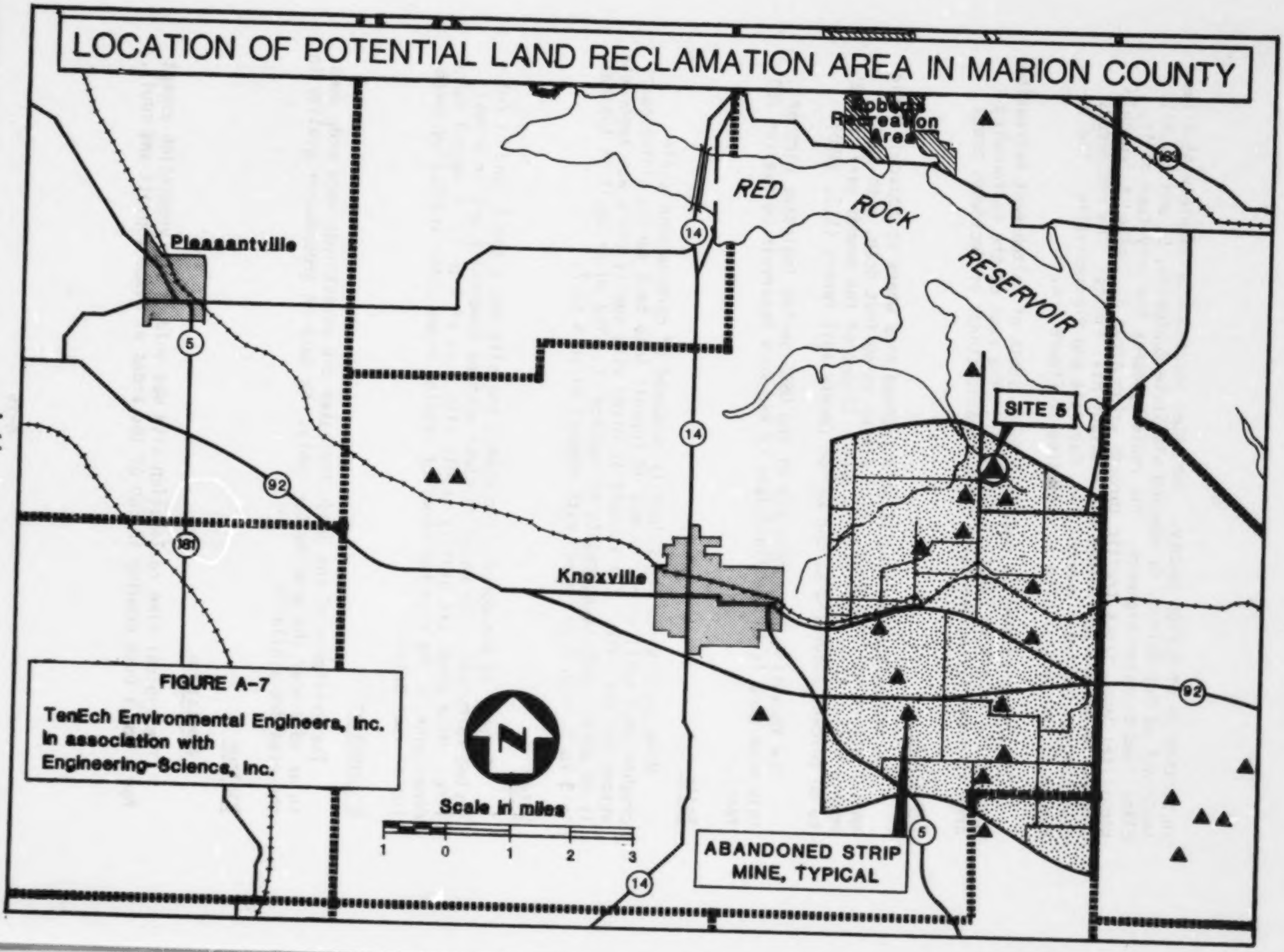
Landfilling is by the area method. Roughly, a 200- by 200-foot area is excavated and then filled. Daily cover is 6 inches of soil, intermediate 18 inches, and final 24 inches. Sludge is mixed in with the general waste. At one time, separate sludge disposal cells were tried; however, this caused operational difficulties.

Sludge volumes average nearly 900 tons per month (860 tons per month in 1980; 890 tons per month in 1979). The landfill receives all the sludge from the Des Moines Main Plant (by far the largest volume), Highland, and Pleasantville. Sludge deliveries are limited by the landfill operator during wet periods. Charges for sludge were previously $3.40 per ton. The Agency lowered this fee to $2.40 in August of 1979 at the request of the city. Total yearly cost for the three plants is, thus, approximately $25,000 for disposal only.

SITE 5 - REPRESENTATIVE ABANDONED MINE SITE

The potential land reclamation areas are abandoned strip mines in Marion County. These sites are spread throughout the county; however, transportation requirements make the area along State Route 92 near the intersection of County Road S-71 the most feasible. This area has a number of abandoned sites in close proximity of one another. Setting an arbitrary limit of 3 miles on either side of Route 92, over a dozen abandoned mines are located in these boundaries. Figure A-7 shows the location of this area. Abandoned strip mines range from 10 to 1,000 acres according to the Marion County soils report (SCS, 1980).

A representative mine was selected as a typical land reclamation site. The spoil area encompasses approximately 120 acres along County Road S-71


Roberts Recreation Area
RED ROCK RESERVOIR
SITE 5
Pleasantville
Knoxville
5
14
92
161
163
N
Scale in miles
1 0 1 2 3
ABANDONED STRIP MINE, TYPICAL

LOCATION OF POTENTIAL LAND RECLAMATION AREA IN MARION COUNTY

FIGURE A-7

TenEch Environmental Engineers, Inc.
In association with
Engineering-Science, Inc.

in Section 26 of Marion County. The site, located approximately 45 miles southeast of Des Moines, is reached via State Routes 45, 5, and 92, all classified as major highways. The route bypasses the only town on it, Knoxville; thus, truck traffic through urban areas is limited to roughly 3 miles inside the Des Moines and Pleasant Hill limits. The route does pass through two small communities, Carlisle and Pleasantville. The location of the typical site is indicated in Figure A-8.

The abandoned mine is roughly 2 miles south of Whitebreast Recreation Area, a state park on Red Rock Reservoir. The rest of the surrounding area is primarily agricultural with sporadic stands of deciduous trees.

Topography

The representative area is an abandoned mine where no apparent reclamation effort has been made. Pits are up to 40 feet deep, with spoil mounds rising to greater than 30 feet. Slopes of the mounds vary from 25 to 80 percent according to the Marion County soil report (SCS, 1980).

The Knoxville quadrangle map of the USGS series indicates part of this mine area is in the floodplain of Red Rock Reservoir (elevation 750 feet).

Soils

Mine spoil sites are primarily composed of carbonaceous shale crushed into small stone. Areas of topsoil laid back during mining operations dot the site. The topsoil is mixed with spoil; there was apparently no effort made to segregate or replace it. The pH of spoil is typically 3 to 5, with areas mixed with topsoil of pH 5 to 7.

Water

Typical of abandoned strip mines, the site has a small pond of collected rainwater. The water is clear with no apparent plant or animal life. Mine ponds are usually acidic with a pH of 4 to 7. A second abandoned mine in the area had ponds of reddish brown color indicating leeching of iron oxides.

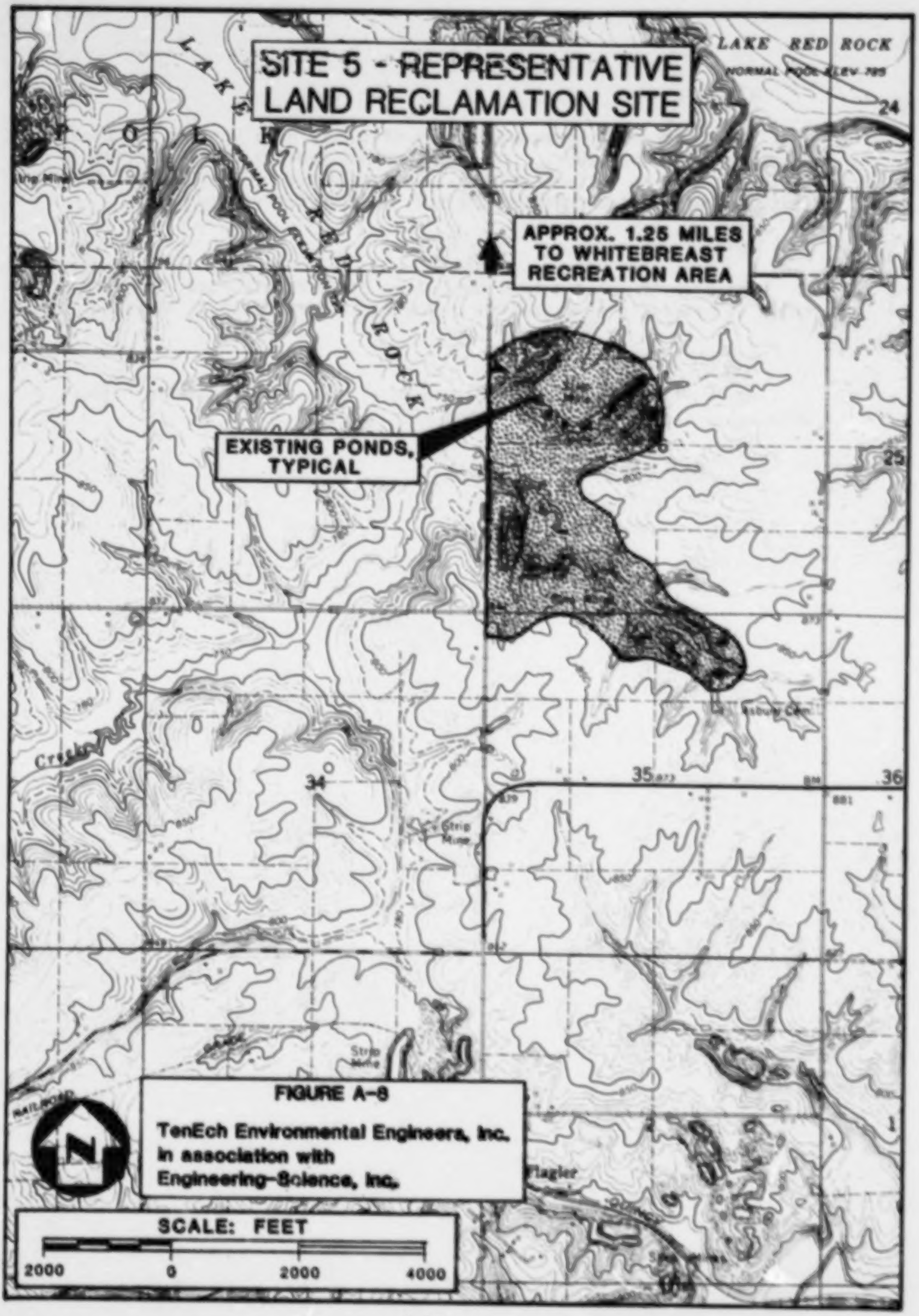
Groundwater

The existence of the ponds indicates the excavations were made down to or very near the groundwater table. No data on groundwater quality in the area are available.

Biology

Vegetation

The typical mine reclamation site was void of any vegetation except for a small bush growing in one of the areas of mixed topsoil and spoil.



SITE 5 - REPRESENTATIVE LAND RECLAMATION SITE

FIGURE A-8

TenEch Environmental Engineers, Inc. in association with Engineering-Science, Inc.

LAKE RED ROCK
NORMAL POOL ELEV 725
LAKE RED ROCK
APPROX. 1.25 MILES TO WHITEBREAST RECREATION AREA
EXISTING PONDS, TYPICAL
24
25
34
35
36
1
Creek
Strip Mine
Flagler
RAILROAD
N
SCALE: FEET
2000
0
2000
4000

Wildlife

The abandoned mine is a severely disturbed area void of any plant growth as described above. The spoil mounds provide a very sterile environment with no resident species. A single set of small animal tracks (raccoon) were noted crossing the soft area bordering the pond.

Noise

The mine is located in a rural area off a county road. Ambient noise is primarily from traffic to the state park north of the site.

Air Quality

Again, the mine is located in a rural area. Air quality is good, with no noticeable odor associated with the site.

APPENDIX B

COMMENTS AND RESPONSES

The Nature Conservancy
Iowa Field Office / 424 - 10th Street, Suite 304 / Des Moines, Iowa 50309 / (515) 244-5044

February 18, 1982

Mr. John J. Franke, Jr.
Regional Administrator
U.S. Environmental Protection Agency
Region VII
324 East Eleventh Street
Kansas City, Missouri 64106

Dear Mr. Franke,

We are in receipt of one copy of the Draft Environmental Impact Statement for Sludge Disposal dated January, 1982. In the future these reports should be directed to Mr. Bob Howe, Coordinator, Iowa Natural Areas Inventory, Wallace State Office Building, Des Moines, Iowa 50319.

Thank you for your attention to this matter.

Sincerely,

Larry Cantera

Lawrence Cantera
State Director

FEB 23 1982

LC/ba

RECEIVED
[illegible]
EPA Region VII

EPA
FEB 22 1982
PLMG DIVISION

National Office / 1800 North Kent Street / Arlington, Virginia 22209

Response:

No response required.

STATE OF IOWA

Office for Planning and Programming

523 East 12th Street, Des Moines, Iowa 50319   Telephone 515/281-3711

ROBERT D. RAY
Governor
EDWARD J. STANEK, PhD
Director

February 19, 1982

John J. Franke, Jr., Regional Administrator
U.S. Environmental Protection Agency
Region VII, 324 East 11th Street
Kansas City, Missouri 64106

RE: SAI Letter of Intent
Project:Draft EIS, Sludge Disposal
in Des Moines Integrated Community
Area, EPA 907/9-82-001

Dear Mr. Franke:

The above-named material has been received in the state clearinghouse. Your proposed project has been assigned State Application Identifier Number IA820219-518 . This number should be included on the application you forward to the federal agency.

As the state clearinghouse is waiving the right to review applications for federal assistance originated by local jurisdictions or private organizations, you will not receive a clearance form. The reviews, however, continue to be required at the area or local level. The areawide clearinghouse in your area is NA

If we may be of assistance to you in any problems you have with state or federal agencies regarding your application, please contact us.

Sincerely,

A. Thomas Wallace

A. Thomas Wallace
Federal Funds Coordinator

ATW:abb

OH-11

EPA
FEB 22 1982
PL.NG DIVISION

FEB 23 1982

RECEIVED
FEB 23 1982
EPA Region VII

Response:

No response required.

U.S. Department of Housing and Urban Development
Region VII

In Reply Refer to:

Professional Building
1103 Grand
Kansas City, Missouri 64106

March 1, 1982

Mr. John J. Franke, Jr.
Regional Administrator
U.S. Environmental Protection Agency
324 East 11th Street
Kansas City, Missouri 64106

Dear Mr. Franke:

Subject: Draft Environmental Impact Statement for Sludge Disposal - Des Moines, Iowa (January 1982)

This is to acknowledge that the subject draft environmental impact statement has been received by this office. It is being reviewed at the Omaha Area Office by the Environmental Officer, as follows:

Mr. Stan Quy, Environmental Officer
Department of Housing and Urban Development
Omaha Area Office
7100 West Center Road
Omaha, Nebraska 68106
Telephone: FTS 864-9371

Mr. Quy will review the statement and provide comments, if any, directly to Mr. Edward Vest, EIS Coordinator, by April 19, 1982.

Sincerely,

Gary D. Ultican
Regional Environmental Officer
Office of Regional Community
Planning and Development

MAR 3 1982

Response:

No response required.

IOWA STATE HISTORICAL DEPARTMENT
DIVISION OF HISTORIC PRESERVATION

ADRIAN D. ANDERSON, DIRECTOR
STATE HISTORIC PRESERVATION OFFICER

March 23, 1982

Mr. John J. Franke, Jr.
Regional Administrator
U.S. Environmental Protection Agency
324 East Eleventh Street
Kansas City, Missouri 64106

RE: Draft EIS for Sludge Disposal in the Des Moines Integrated Community Area, Polk County, Iowa.

Dear Mr. Franke:

1. Thank you for providing us the opportunity to review and comment upon the Draft Environmental Impact Statement for Sludge Disposal in the Des Moines Integrated Community Area.

2. We note that the plans include consultation with the State Historic Preservation Officer when specific disposal sites and techniques are chosen. Since this consultation will take place before any land modification, the Division has no objection to this draft EIS.

If the Division can be of further assistance, please let us know.

Sincerely,

Adrian D. Anderson

Adrian D. Anderson
State Historic Preservation Officer

cc: Morris Preston, DEQ

[illegible]EIVED
1982

26 EAST MARKET STREET • IOWA CITY, IOWA 52240 • TELEPHONE (319) 353-4186 / 353-6949

Response:

1. No response required.

2. Coordination with the State Historic Preservation Officer will indeed be undertaken before any land modifications are made such as those that may be required for interim sludge storage sites.

United States
Department of
Agriculture

Soil
Conservation
Service

693 Federal Building
210 Walnut Street
Des Moines, Iowa 50309

March 23, 1982

Mr. Edward Vest
E.I.S. Coordinator
U. S. Environmental Protection Agency
Region VII
324 East Eleventh Street
Kansas City, Missouri 64106

Dear Mr. Vest:

We have received and reviewed the Draft Environmental Impact Statement for Sludge Disposal in the Des Moines Integrated Community Area, dated March 3, 1982 and we have no comments.

The Polk County Soil Conservation District has provided assistance to the consultants involved with this study.

Sincerely,

William J. Brune

William J. Brune
State Conservationist

The Soil Conservation Service
is an agency of the
Department of Agriculture

Response:

No response required.

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Control
Atlanta, Georgia 30333
(404) 262-6649

April 14, 1982

Mr. Edward Vest
EIS Coordinator
U.S. Environmental Protection Agency
Region VII
324 East Eleventh Street
Kansas City, Missouri 64106

Dear Mr. Vest:

1. We have reviewed the Draft Environmental Impact Statement (EIS) for Sludge Disposal in the Des Moines Integrated Community Area, Iowa. We are responding on behalf of the U.S. Public Health Service and are offering the following comments for your consideration in preparing the Final EIS.

2. In general, we have no major objections to the proposed project provided satisfactory safeguards are incorporated into the project to minimize potential adverse public health risks and to protect public health. We are concerned about the potential impacts to surface and subsurface water resources in the vicinity of the land application areas. In particular, special attention and care must be taken by the responsible local entities to protect public and private drinking water supplies and air quality from adverse impacts associated with the treatment, transport, stockpiling, and application of sludge.

3. Since "land application of sludge could affect both nitrate and heavy metals concentration in shallow wells," special measures and conditions should be included into the proposed land application plan to regulate and control the application of fertilizer nitrogen, accumulation of heavy metals or other toxic and hazardous substances in the site soils and/or discharge of these substances and/or pathogens from the site in order to minimize potential health impact. Proposed surveillance activities should include continuous well monitoring and a contingency program for the application areas in order to identify and respond to potential well contamination problems as early as possible.

4. To reduce potential risk to susceptible populations, we agree that application areas, as well as stockpiling and handling areas, should be as far as possible from hospitals, health care facilities, schools, child care facilities, nursing and retirement centers, and other potentially sensitive populations. Sludge application areas should be periodically monitored by responsible entities to insure that (1) domestic animals are not being allowed to graze prematurely on these areas and that (2) human food crops are not being grown and harvested before soils are considered safe.

5. Drainage systems, sludge storage areas and retention ponds should be designed and/or managed by the project sponsor or responsible local entities to prevent

APR 16 1982

the increase of any vector populations that have the potential to cause vector-borne disease or nuisance problems. HUD should determine from local health authorities if a history of vector-borne disease and nuisance problems exists in the area. Naturalistic controls that should be considered in the design of storage areas, ponds and drainage systems are discussed in Mosquitoes of Public Health Importance and Their Control. This document is available from our agency upon request.

6. We appreciate the opportunity to review this Draft EIS. Please send us one copy of the final document when it becomes available. Should you have any questions about our comments above, please call Mr. Robert Kay of my staff or me at FTS 236-6649.

Sincerely yours,

for Chester L. Foster, Jr.
Frank S. Lisella, Ph.D.
Chief, Environmental Affairs Group
Environmental Health Services Division
Center for Environmental Health

Response:

1. No response required.

2. No response required.

3. The measures suggested are present in the Iowa Department of Environmental Quality regulations governing land application of wastewater sludges (IDEQ Rules, Title IV, Chapter 33, effective November 21, 1979). Strict enforcement by IDEQ of these rules is anticipated.

4. Periodic monitoring of sludge disposal areas will be conducted by the Iowa Department of Environmental Quality as well as the Des Moines ICA agency.

5. Design and management of sludge storage areas will be the responsibility of the project sponsor, the Des Moines ICA agency.

6. No response required.

CITY OF DES MOINES

ADVISORY COMMITTEE ON
ENVIRONMENTAL QUALITY
EAST FIRST AND DES MOINES
DES MOINES, IOWA 50307
(515) 283-4244
1949 ALL-AMERICA CITY 1976-77

April 16, 1982

To Whom It May Concern:

At its meeting of March 25, 1982, by a vote of 5-0 the Des Moines Advisory Committee on Environmental Quality adopted a resolution in support of the findings and conclusion as presented in the Draft Environmental Impact Statement for Sludge Disposal. The Committee expressed an appreciation of the thoughtfulness and genuine concern for the environment displayed by the Report.

Greg Nepstad by RZB
Greg Nepstad, Chairman -
Des Moines Advisory Committee
on Environmental Quality

Response:

No response required.

United States Department of the Interior
OFFICE OF THE SECRETARY
OFFICE OF ENVIRONMENTAL PROJECT REVIEW
Room 688, Building 67
Denver Federal Center
Denver, Colorado 80225

IN REPLY REFER TO:
ER 82/317

MAR 3 1 1982

Mr. John J. Franke, Jr.
Regional Administrator
U.S. Environmental Protection Agency
324 East Eleventh Street
Kansas City, Missouri 64106

Dear Mr. Franke:

1. This is in response to the request to the Department of the Interior for comments on the draft environmental statement for sludge disposal in the Des Moines Integrated Community Area, Iowa.

2. The statement indicates that in portions of sites 1, 2, and 3 the water table will be seasonally or occasionally at or near the land surface (p. A-4 to A-9, A-12). At site 4 (Metro Park East) the depths to ground water are estimated as 20 to 30 feet; however, at Metro Park West depths to water in the spring and in wet periods range from only 1-1/2 feet to 3 feet (p. A-12). At site 5 strip mines have reached or penetrated the water table (p. A-15). The statement should more thoroughly evaluate ground-water impacts and possible mitigation at these sites.

3. Known mineral resources of the area include coal, gypsum, clay, shale, and sand and gravel. Cement, clay, shale, and sand and gravel are produced at facilities near Des Moines. The DES does not mention mineral resources or facilities except for noting that abandoned coal strip mines were considered as sludge disposal sites and citing that as one alternative (No. 5). Although the preferred alternative would utilize only agricultural lands as disposal sites, the document states repeatedly that if Alternative 5 were chosen, beneficial environmental impacts would occur. The report makes no mention of adverse impacts that might result from such action. Coal in the project area has little current value, but it may again become a useful resource in the future. Disposal of sludge in the abandoned pits might preclude such recovery.

4. The final environmental statement should quantify and describe the coal resource, and should discuss the effect that using the old mines as disposal sites might have on any future coal recovery. We do not anticipate significant conflict between the planned sludge disposal and other mineral resources or producing facilities in the area. We would suggest, however, that the other mineral resources be listed and a statement added indicating that they would not be affected by the disposal plan.

5. There is a potential that a limited amount of parkland with the Des Moines Integrated Community Area might be utilized for pilot tests to demonstrate the effects of sludge application on typical crops grown within the area (p. 119, par. 5). It also is stated that if parkland is utilized for public access to the test plots, it would have to be restricted for a 2-month period following sludge application. Prior to selection of any park sites for this project the Iowa State Liaison Officer should be consulted in order to determine if there will be a conflict with the provision of 6(f) of the Land and Water Conservation Fund Act of 1965 as amended. Park projects funded under this act cannot be converted to other than outdoor use without the concurrence of the Secretary of the Interior. The State Liaison Officer responsible for these projects is Larry J. Wilson, Director, Iowa Conservation Commission, Wallace State Office Building, East Ninth and Grand, Des Moines, Iowa 50319.

6. We also suggest that consideration be given to conversion of abandoned strip mines to park lands either prior to the selection of sites for sludge disposal or after disposal has been completed. Such sites often provide excellent recreational opportunities and there are numerous examples of such conversions in communities throughout the country.

Sincerely,

Robert F. Stewart
Robert F. Stewart
Regional Environmental Officer

Response:

1. No response required.

2. Detailed groundwater impacts are provided in Chapter IV, Groundwater section (pages 79-81).

3. No response required - see response #4.

4. Mineral resources such as coal, gypsum, clay, shale, and sand and gravel will not be adversely affected by the proposed action (i.e., land application of dewatered sludge). This activity does not preclude future extractions or utilization of any mineral resources which may be found in agricultural areas subject to land application.

With regard to coal resources and associated impacts due to reclamation of abandoned coal pits, no adverse impacts upon coal resources are expected. Two references indicate coal reserves present in Marion County; "Coal Resources of Iowa, Technical Paper #4," 1965, by E. R. Landis and Strippable Coal Resources

Responses (continued):

Studied in Select Counties, 1975, by U.S. Bureau of Mines, Grant Number G0254008. The first reference examined coal seams fourteen inches or thicker, while the second reference dealt with coal seams greater than twenty-eight inches in thickness. Landis estimated that Marion County contained 645.16 million short tons of which only 37.04 million short tons had been extracted through 1963. The U.S. Bureau of Mines estimate that 297.41 million short tons are present with 85.03 million short tons being measured or indicated. No individual county coal reports are available later than 1963, however, only one-half million short tons have been extracted annually in Iowa since 1963. The quality of the coal in Marion County is generally poor by today's standards. Marion County is situated in Iowa's Southern Drift Plain which contains primarily lignite coal. Lignite is a brownish black coal intermediate between peat and bituminous coal. It should be noted that there used to be no restrictions on coal strip mining. Consequently, coal seams were either completely extracted or mined only to the point where it was economical to do so. This appears to be the case in the abandoned coal pits at Site 5. Inspection of the highwalls there reveal that visible seams are only several inches thick at most. It is believed that reclamation of these areas now would not preclude future mining activities at these sites if such recovery were ever to become economically viable. It should be noted that the University of Iowa is presently reclaiming strip mines with sludge in other areas.

5. At the present time, it appears that no parkland will be utilized for demonstration plots. Previous experience with land application of sludges in Iowa have resulted in wide public acceptance of the practice. Consequently, demand for sludge from the Des Moines Wastewater Treatment Plant is presently at a great enough level to not warrant demonstration programs. However, if any parkland is proposed for sludge application, the Iowa State Liason Officer, Mr. Larry Wilson, Director, Iowa Conservation Commission, will be consulted to determine if any 6(f) conflicts are present.

6. Presently, an abundance of recreational lands exist within Marion County where the abandoned coal mines are located. According to the Initial Central Iowa Outdoor Recreation Plan, Central Regional Planning Commission, 1972, Marion County contains 3,638 acres of Class I, II, and III recreation lands. Classes I, II, and III lands consist of recreational lands designated for high density recreation, general outdoor recreation, and natural environmental areas, respectively. In addition to these 3,638 acres, another 45,940 acres of reserved open space and undeveloped recreational land are also present. This additional land primarily consists of Lake Red Rock which extends into Polk and Warren Counties. The above referenced recreation plan recommends a minimum standard of 58 acres of Class I, II, and III lands for per 1,000 population. The current ratio is 122 acres/1,000 population (utilizing the 1980 county population and assuming no additional recreational lands). Further, the cited recreation plan projects a 1,760-acre recreational land excess for the county in the year 2000. It should also be noted that the abandoned coal mines considered for reclamation are located within five miles of Lake Red Rock and associated camping, fishing, picnicing, and other outdoor recreational facilities. For these reasons, conversion of reclaimed coal pits to recreational land will most likely receive little consideration.

U.S. Department of Housing and Urban Development
Omaha Area Office, Region VII
Univac Building
7100 West Center Road
Omaha, Nebraska 68106

May 6, 1982

Mr. Edward Vest
EIS Coordinator
U.S. Environmental Protection Agency
324 East 11th Street
Kansas City, MO 64106

Dear Mr. Vest:

I have received the draft Environmental Statement for Sludge Disposal in the Des Moines Integrated Community, and have found the document to be satisfactory in meeting the spirit and intent of the National Environmental Policy Act of 1969.

This determination was made on the basis of the following considerations: (1) HUD's areas of review responsibility in accordance with NEPA, and (2) HUD's activities in the Des Moines area that might be affected by the Environmental Statement.

Sincerely,

Stanley V. Quy
Environmental Officer
Office of the Area Manager, 7.2SS

Response:

No response required.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

DATE May 7, 1982

SUBJECT Des Moines, Iowa Draft EIS for Sludge Disposal

FROM Jerry M. Anderson
Chief, Iowa-Nebraska Section, CNGR

TO Edward C. Vest
EIS Coordinator

THRU: Larry B. Ferguson
Chief, Construction Grants Branch

Allan S. Abramson, Ph.D.
Director, Water Management Division

We have reviewed the January 1982 "Draft Environmental Impact Statement for Sludge Disposal" for the Des Moines Integrated Community Area (ICA), and at this stage of review the selected alternative, designated Alternative 1a, is acceptable. Additionally, a Public Hearing on April 6, 1982 revealed no adverse local reaction to the proposed alternative.

We would like the opportunity to evaluate the final EIS when it becomes available.

Response:

No response required.

1320-6 (Rev. 3-76)

APPENDIX C

PUBLIC HEARING TRANSCRIPT

UNITED STATES OF AMERICA

ENVIRONMENTAL PROTECTION AGENCY

- - - - - - - - - - - - - - - -

In re:

Draft Environmental
Impact Statement
For Sludge Disposal
in the Des Moines
Integrated Community
Area.

- - - - - - - - - - - - - - - -

City Council Chambers,
East First and Locust,
Des Moines, Iowa,

Tuesday, April 6, 1982.

The public meeting in the above-entitled matter was convened, pursuant to notice, at 7 o'clock p.m., Ellen Goldman, presiding.

PRESENT:

PANEL

ELLEN GOLDMAN,
United States Environmental
Protection Agency,
Region VII,
324 East Eleventh Street,
Kansas City, Missouri, 64106.

PANEL (Continued)

DANIEL E. STROBRIDGE,
Environmental Planner,
Tenech Environmental
Consultants,
515 Park Avenue,
Louisville, Kentucky, 40208.

JOSEPH L. PAVONI, Ph.D., P.E.,
Tenech Environmental
Consultants,
515 Park Avenue,
Louisville, Kentucky, 40208.

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best available copy.

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STATEMENT OF:

Daniel [illegible]. Strobridge 6

Marilyn [illegible]. Staples 9

Adjournment (7:20 p.m.) 15

Reproduced from best available copy.

PROCEEDINGS

HEARING OFFICER GOLDMAN: We will come to order.

I am an attorney with the Office of Regional Counsel, at the Environmental Protection Agency, Region VII.

I have been designated to act as the Hearing Officer for this meeting by John Franke who is the Regional Administrator.

Here tonight from the EPA are Ed West and Tom Lorenz, who is the principal EIS preparer.

There are also some people here from the city who can answer your questions and Dan Strobridge, who is the representative of the consultant who prepared the EIS.

This hearing is being held tonight pursuant to Title XXXX CFR 6.400.

The purpose of this hearing tonight is to give all of you a chance to comment on the draft EIS, to raise any questions, and if we cannot answer them tonight, they will be answered at least ultimately in the final EIS.

This hearing is being transcribed and if you want a copy of the transcription, you can also get that by writing to us at EPA, and this is going to be at your cost, of course.

You can have a copy of the final EIS and if you want a copy of that, I put a legal pad over there (indicating) for you to sign up, and you might want to do that before you leave, and we will get you a copy when it is completed.

I noticed that nobody indicated that they wanted to make a comment on the cards that were available there.

If you decide later on that you feel that you want to make a comment, please feel free to raise your hand.

Dan is going to make a brief presentation to illustrate the alternatives.

After that, I will call for any kind of questions or comments.

If you do want to, please come up to the podium and state your name and speak clearly, because the court reporter will need to hear it.

Dan.

MR. STROBRIDGE: Thank you, Ellen.

HEARING OFFICER GOLDMAN: Excuse me, one final thing.

The comment period is until when, Tom?

MR. LORENZ: April 19th.

HEARING OFFICER GOLDMAN: April 19th?

MR. LORENZ: Yes.

HEARING OFFICER GOLDMAN: If there is anything said tonight that triggers something later on, you can comment to us until April 19th.

I am sorry, proceed, Dan.

MR. STROBRIDGE: Thank you, Ms. Goldman.

STATEMENT OF DANIEL E. STROBRIDGE,
ENVIRONMENTAL PLANNER,
TenEch,
Environmental Consultants

MR. STROBRIDGE: In addition to the proposed action and the no action alternative, we also considered nine other alternatives.

Briefly, the no action alternative would entail the continued use of existing solids management facilities at the Des Moines main plant.

Basically, that infiltration, well, it would be digestion, anaerobic digestion, venting the methane gas into the atmosphere, vacuum filtration, followed by landfill disposal of the solids.

The proposed action involves dissolved air flotation which is Alternative 1a which is the proposed action.

It would be dissolved air flotation followed by anaerobic digestion.

The gas would be stored and used for in-plant purposes. Dewatering would be by a belt filter press and truck transport the solids and we would land apply dewatered sludge.

As the back-up to that primary system, we would be landfilling the sludge, possibly going with liquid sludge land application, avoiding the dewatering stage, or as a periphery back-up system using land reclamation.

Now, getting into the alternatives in addition to that, Alternative 1b is exactly the same, other than for the means of dewatering and we would use a centrifuge instead of belt filter press there.

We also considered basically a composting type system, again, dissolved air flotation, dewatering with belt filter press,--composting would then be by the aerated pile method,--truck transport, and the compost would be marketed as a fertilizer.

The third alternative that was considered--again, there are suboptions again--and that is only the method by which the sludge can be dewatered and basically that is a landfill as an ultimate disposal method.

Again, the anaerobic digestion, we would capture the gas and use it for in-plant uses.

Then 3a involved or involves the belt filter press against the centrifusion, 3b, again, truck transport, and the existing Metro East Landfill would be the ultimate disposal site for the sludge.

The fourth alternative involves no dewatering step and we would land apply the liquid sludge and that would be by injection with a chisel plow, tubes run behind it, and that would be injected and incorporated directly in the soil.

Again, truck transport would be utilized for that.

We also looked at another composting method of sludge stabilization and that other method would still be aerated pile, but the ultimate disposal would be reclamation of abandoned strip mines and then truck transport would be utilized, belt filter press for dewatering the sludge.

The sixth is also a composting type of alternative. Instead of using land reclamation for ultimate disposal, we would simply landfill the compost.

The seventh alternative and the suboptions are kind of a combination of previously considered options and alternatives. That involves dissolved air flotation and, again, anaerobic digestion.

The options include the method of sludge dewatering, truck transport and again that was land application of abandoned strip mines.

Those were the alternatives considered. I am not going to get into the impacts, a detailed description of the impacts associated with each of those.

The draft EIS has been in circulation for a number of days now, but we would be glad to answer any specific questions regarding, with regard to the impact associated with any of these alternatives considered.

HEARING OFFICER GOLDMAN: Are there any questions or comments?

MS. STAPLES: I apologize, I only got through Page 105 of the book, and as I had questions arise, I found that the majority of them were answered in the text farther on.

I am Marilyn Staples and I am part of the Citizens Advisory Committee.

STATEMENT OF MARILYN STAPLES,
DES MOINES AREA WASTEWATER PROJECT,
CITIZENS ADVISORY COMMITTEE

MS. STAPLES: It seems to me there are two questions that I still have not had answered to me, for my own satisfaction.

One has to do with the life expectancy of the Metro East Landfill under the various alternatives. That is not spelled out anywhere that I have found in the text and I think that that is an important economic consideration.

I may be wrong in that, but if there is some data available, I do believe that it should be part of the final draft.

The other question that arose and is not dealt with satisfactorily is that of the reclamation of strip mines in the Knoxville-Marion County area. As I take a look at some of that land, it is not highly productive land in terms of anything, but pastural land.

I do not know the benefits to the owners of the land. It seems to me that would involve tremendous amounts of dirt moval in order to use the sludge and that, again, is a question that I would like to have dealt with somewhere along the line, unless someone could answer that this evening.

MR. STROBRIDGE: The second question, basically, is how would that--

MS. STAPLES (interrupting): What benefit is there to the owner of that land to move the tremendous amount of soil that would be involved in reclaiming that land with the application of the sludge no matter what state the sludge is in, that is, very hilly land does not lend itself--

MR. STROBRIDGE (interrupting): The land--

MS. STAPLES (continuing): --to anything really besides pasture.

MR. STROBRIDGE: The land we were specifically looking at was essentially, it did not have any vegetation of any sort. As such, it is of no use for any purpose at this point. It is not even to the point of being pasture land.

MS. STAPLES: I realize that. Is there enough benefit to putting that in pasture to be worth moving the soil around, because it is just piled in heaps with usually stagnant water at the center.

MR. STROBRIDGE: Right. Basically there or the basic thought there is that the present topography or preservation is itself a negative condition, but the efforts involved in that for a specific reclamation site would have to be worked with the owners as to how it is done.

It would be a positive improvement to the existing condition.

MS. STAPLES: Anything would be an improvement.

I just do not know whether the cost benefit would be there for the amount of soil that would have to be moved.

MR. BLASWEL: Yes, but that would have to be on a case by case basis. I think that is about all you can say at this point, that the cost of the alternative incorporated the cost involved in doing that.

MR. STROBRIDGE: I think we don't have a precise cost benefit analysis done with regard to the mine reclamation alternatives, however, we have calculated present worth costs of the mine reclamation alternatives against other alternatives.

This is the compost mine reclamation alternative and it is the present worth cost and that is 27 million. These two are the dewatered sludge mine reclamation alternatives, and you can see those are 29 and 29.5 million dollars, as opposed to the preferred or proposed alternative of 30.

So just from that, that is not really a cost benefit that I am showing you.

What I am showing you is the present worth cost and by this, in these types of calculations, when you are dealing with present worths that are that close together, it is very difficult without going, as

John said, on a state by state basis, to really get into evaluating cost versus benefit.

I hope that that helps to answer your question.

MS. GOLDMAN: Do we have an answer for the first question?

MR. STROBRIDGE: I believe the life expectancy of the current Metro East Landfill is probably 1987 as it is presently operated; if we continue then to landfill sludge under the landfilling alternatives, that life expectancy would not be expected to change.

We would consume the landfill capacity at roughly the same rate we are now.

So, consequently--

MS. STAPLES (interrupting): Reclamation-- and, in effect, you extend the life of the land then.

MR. STROBRIDGE: Yes, with land application or with land reclamation, we would extend the life of then that landfill, however, I cannot give you an exact number of years at this point.

MS. STAPLES: Thank you very much.

MR. PAVONI: One other comment about the land reclamation alternative is the fact that with the present worth costs as close as they were, the environmental impact of land reclamation was, obviously, more beneficial than any of the other alternatives because of the starting point of the land reclamation areas and that is definitely what is stated in the EIS.

Whether or not it is worth it to actually implement it is another question.

MR. STROBRIDGE: All right. We used something called the reference alternative method for evaluating each of these alternatives.

We set existing conditions on our particular sites that we looked at as zero and because the abandoned strip mines received a zero, just as this prime crop land received a zero, obviously, you are going to have a far better enhancement of that particular site with land reclamation than you are of the prime crop land.

But whether those isolated areas, improving those isolated areas, would increase travel distances, and the additional institutional arrangements just necessary to secure that land and basically the IC agency would then end up getting into a revolving land bank like and it is highly questionable whether you would want to go that direction.

MS. STAPLES: Then you would have to go to the City of Knoxville to get down there.

MR. STROBRIDGE: Exactly.

MS. STAPLES: Which is a miserable city to drive through.

MS. GOLDMAN: Are there any other questions or comments?

This meeting is adjourned.

(Whereupon, at 7:20 o'clock p.m., the meeting was adjourned.)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VII
324 EAST ELEVENTH STREET
KANSAS CITY, MISSOURI - 64106

SEP 17 1982

TO: ALL INTERESTED AGENCIES, PUBLIC GROUPS AND CITIZENS

Enclosed is a copy of the Final Environmental Impact Statement (EIS) for Sludge Disposal in the Des Moines Integrated Community Area. This document is submitted pursuant to Section 102(2)(c) of the National Environmental Policy Act of 1969 (Public Law 91-190). All comments on this final EIS must be submitted to the Environmental Protection Agency (EPA) within 30 days after the Notice of Availability of this document is published in the Federal Register. This date of notification is anticipated to be about September 24, 1982; therefore, comments should be submitted by October 25, 1982.

Parties wishing to submit written comments on the final EIS may do so by mailing them to Edward Vest, EIS Coordinator, at the above address by October 25, 1982. A Record of Decision, stating EPA's chosen action on the above Project, will be published following the close of the 30-day public review period.

Copies of the final EIS will be available for review at the Main Branch of The Des Moines Public Library, and the City Engineer's Office, Des Moines City Hall.

Sincerely yours,

William Rice

William W. Rice
Acting Regional Administrator

Enclosure

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